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A GUIDE TO NETWORK CONSTRUCTION AND UTILIZATION. (U)

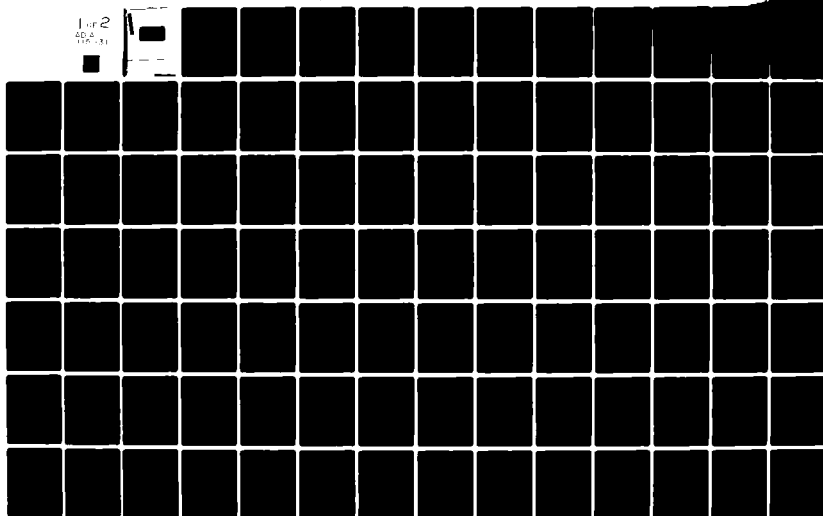
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FINAL TECHNICAL REPORT

A GUIDE TO NETWORK CONSTRUCTION AND UTILIZATION

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PREFACE

Three manuals have been written for the FORECAST 90 Project, a contract jointly funded by the Army and the Defense Advanced Research Projects Agency.

- "A Guide to Network Construction and Utilization"
- "User's Manual for the FORECAST 90 Computer Programs"
- "Programmer's Manual for the FORECAST 90 Computer Programs"

These manuals show how to construct and use networks, how to use the computer programs written for the project, and how to maintain the FORECAST 90 computer programs.

A large number of individuals have contributed significantly to the FORECAST 90 Project. Special mention must be given to Colonel John G. Pappageorge, the project monitor at the Strategic Studies Institute, who formulated the initial concept of FORECAST 90 and followed it through the contract phase with uncommon dedication, insight, and patience. The entire research effort is appreciably better as a result of his many comments, criticisms, and suggestions. Colonel Joseph Pizzi, the Director of the Strategic Studies Institute and Chairman of the Study Advisory Group (SAG), provided assistance and guidance at critical points in the project. Members of and observers to the SAG participated heavily in the research, often raising fundamental questions about the project, and always contributing to a better product. Captain Daryl Steiner and Lieutenant Ron Parker of the ADP Support Group at Carlisle Barracks spent many long hours unraveling the undocumented intricacies of the U.S. Army War College computer system.

CACI's support staff edited and typed draft after draft of the three manuals with unfailing good humor. Particular thanks are due to Carol Franco,

who converted dangling participles and split infinitives into more readable prose, and Sharon O'Rourke, who always found some new way to juggle work loads so that one more part of the three manuals could be completed. Ann Yamat cheerfully typed most of the drafts, with considerable assistance at critical points from Nancy Streeter. We owe a substantial debt of gratitude to each of these individuals.

1. INTRODUCTION TO THE FORECAST 90 PROJECT

The FORECAST 90 contract effort was designed to test a concept originated by the Strategic Studies Institute (SSI) for linking long-range planning requirements to forecasting techniques. Sufficient interest was generated in the concept at the Department of the Army level (DA-DCSOPS) and the Department of Defense level (OSD-ARPA) to warrant a jointly funded program to test the concept. CACI was selected to conduct that test.

As is elaborated in subsequent chapters, the heart of the approach lies in combining trend projection techniques and conflict analysis techniques into a networking system in order to make the risks and opportunities inherent in various decision alternatives visible to the decision-maker. This contract phase focused on two aspects of the overall FORECAST 90 effort: (1) methodological development of a system capable of producing and integrating a variety of plausible "futures" and displaying them in a form readily understandable and usable to Army planners, and (2) demonstration of the utility of that system by producing an initial set of "futures," integrating them, and demonstrating a computer-based system for storing, retrieving, and monitoring the forecasting system.

The basic building block in the system is the network tree. It consists of the following elements (see Figure 1):

- Condition or Trend
- Determining Factors
- Catalytic Event
- Affected Activities
- First-Order Effects
- Second-Order Effects

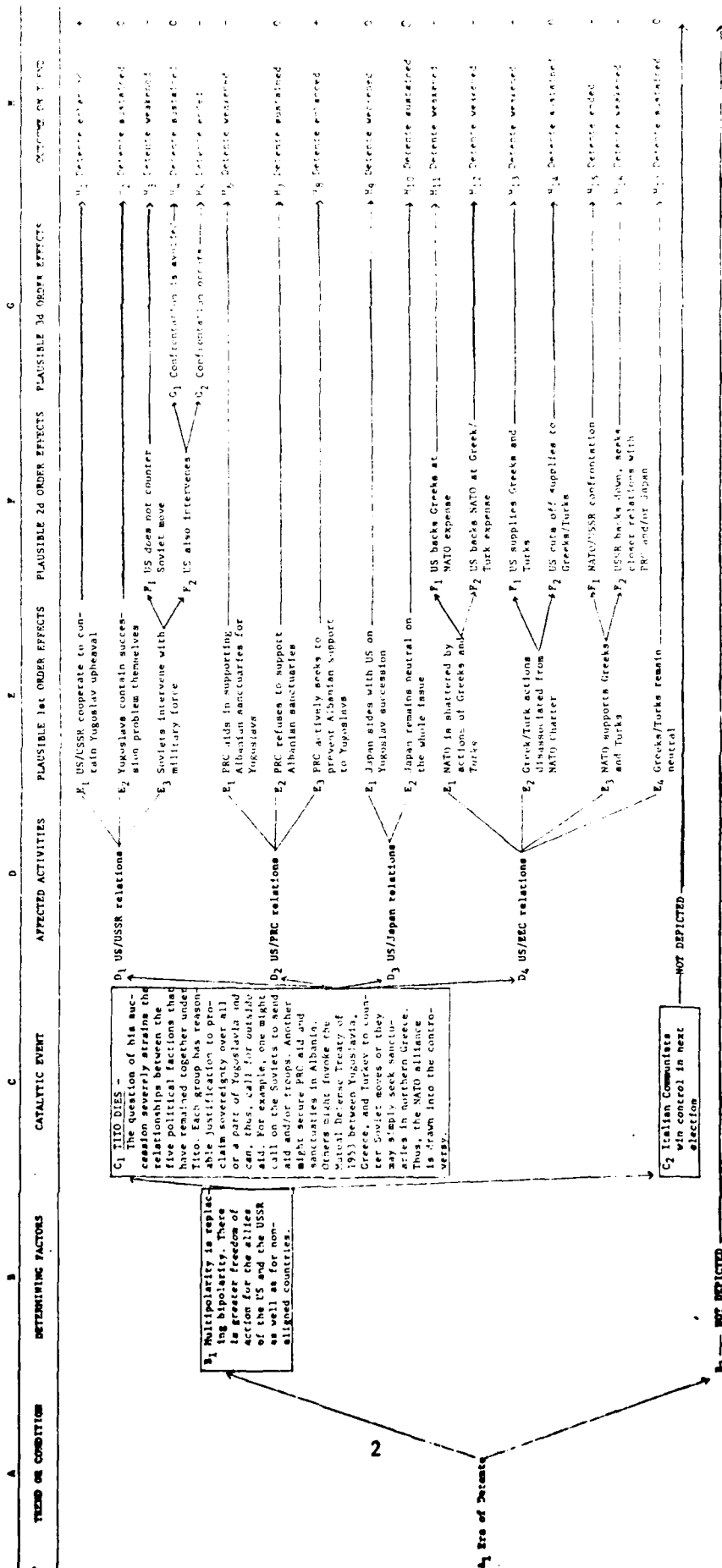


Figure 1. FORECAST 90 Network Structure

- Third-Order Effects
- Outcome on Original Condition or Trend

There are five categories of networks depending on their start points (condition or trend). These reflect the five categories of national power. They are:

- Economic
- Military
- Political
- Socio-Psychological
- Technological

The example in Figure 1 is a political network whose start point is the current political trend toward detente between the United States and the Soviet Union. The left half of the network (columns A through D) is essentially derived by trend projection techniques (Delphi, extrapolation). The right half of the network (columns E through H) is essentially obtained by conflict analysis techniques (war gaming, simulations). The network is circular in that the outcome always expresses the change (+, 0, or -) with respect to the original starting point.

Five categories of networks are deemed necessary for two reasons. First, they divide the work of network construction according to functional area expertise. Second, they allow each network to remain relatively simple and uncluttered so that the decision-maker can see alternative audit trails to each outcome. Yet the world is not simple. Political events influence economic ones and create military outcomes that have social consequences. Any number of interrelated events from any or all of the five categories of power can be influenced by any one or more events in any category. Previous approaches have had great difficulty finding a way to capture and display these interactions.

In the FORECAST 90 concept, each node was to be coded in the network two ways--according to its uniqueness and according to its equivalence with respect to other nodes. If this could be done, then appropriate traces from different networks could be combined based on the matter to be studied. This is shown hypothetically in Figures 2 and 3. Figure 2 shows a political network and an economic network that possess four equivalent nodes (A, B, C, and D), all of which deal with, say, energy. Given that situation, it should be possible for a computer to print out the combined network shown in Figure 3. In this case the particular perspectives of the political scientist and the economist have been preserved while being combined. Thus, anyone studying the energy problem must consider the data contained in each node of the combined network.

The networks have several advantageous attributes, all based on the need for realistic and usable forecast results.

- They are multidimensional, that is, it is possible to deal with a variety of basic world trends, goals, or events simultaneously.
- They produce audit-trails by which the sequence of events leading to any given outcome can be seen. This facilitates their use as decision tools because critical choices can be specifically identified.
- They are computer-stored and retrievable on a high-speed printer. This makes it possible to examine networks quickly.
- They are flexible. The system is designed so that any number of new networks can be built and integrated into the existing set.
- They produce multiple forecasts allowing planning for a plausible range of futures.
- They deal with plausible bounds of actions and outcomes rather than everything possible or a single, "straight-line" forecast. Hence they produce some reduction of uncertainty with minimal loss of richness.
- They are policy tools. They link plausible futures to specific actions by the United States and other governments to produce a range of forecasts that can be used for policy guidance.

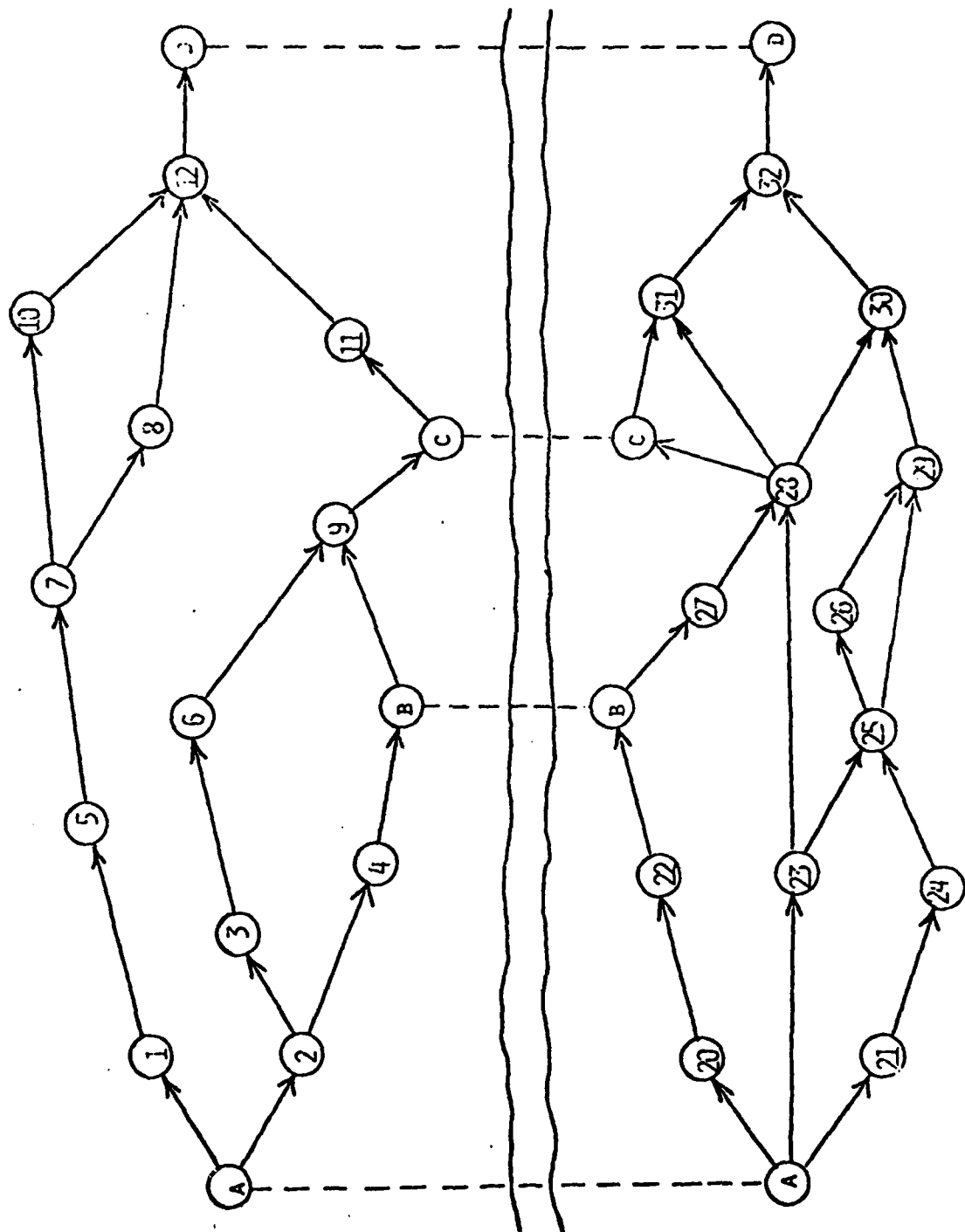
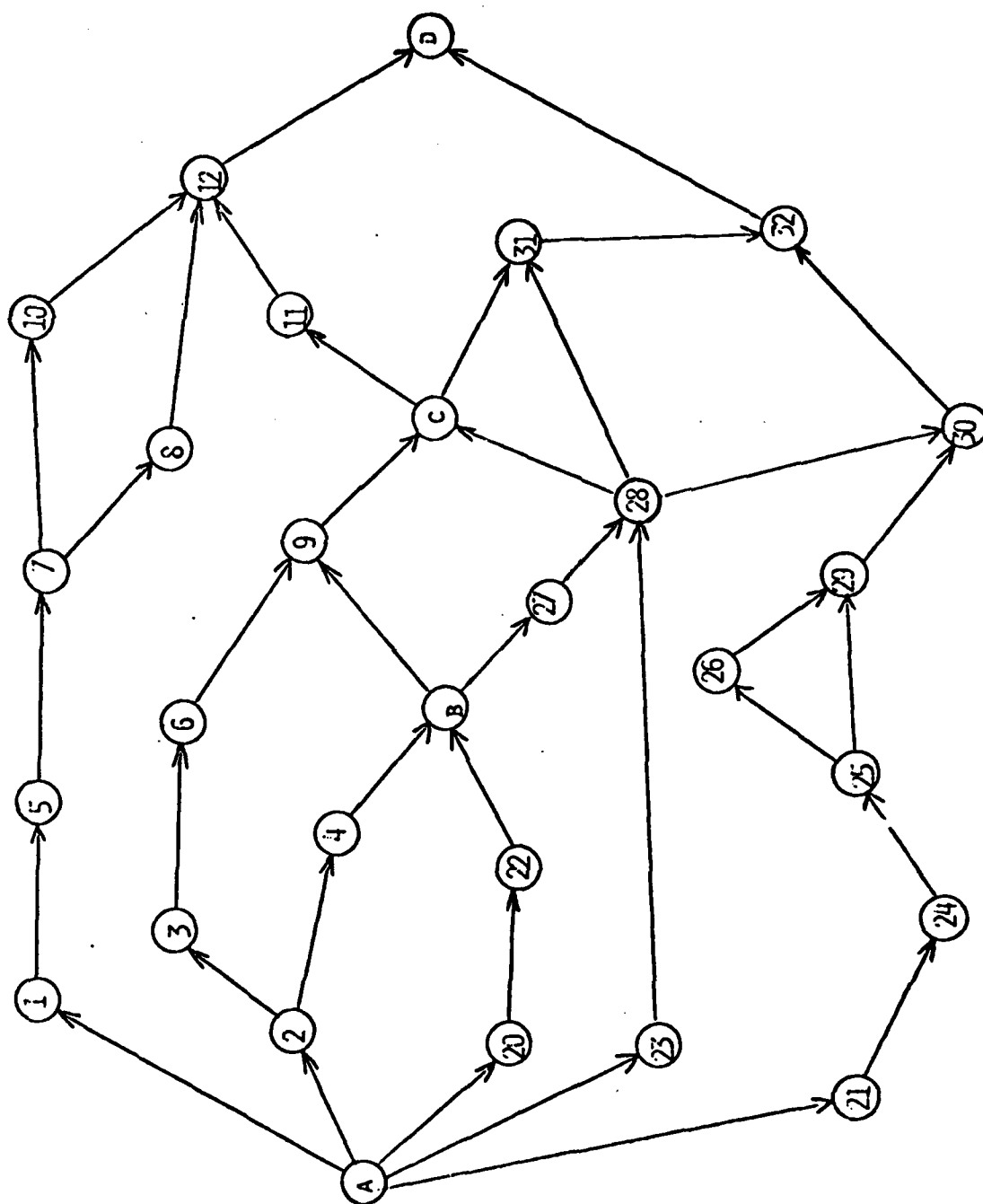


Figure 2. Two Distinct Networks with Potential Cross-over Points



In short, if the concept was successful, the decision-maker or the long-range planner would be able to look at the downstream effects of various decisions he might make today by linking together audit trails from a number of separate networks.

Because the concept had never been proven and the effort at developing and testing it might truly be called a pioneering effort with a high risk of failure, certain safeguards were built into the contract. The contract was executed in four phases. CACI was to be paid a portion of the total contract after successful completion of each phase and the government had the option of terminating the contract if the work completed at that point did not show sufficient promise. A detailed explanation of each phase of the development of FORECAST 90 is explained in subsequent chapters. In brief, the phases are:

- I. Produce Networks (listed in Appendix I)
- II. Code the Networks (unique coding)
- III. Integrate Networks (equivalence coding)
- IV. Produce Three Manuals
 - A "User's Manual for the FORECAST 90 Computer Programs"
 - A "Programmer's Manual for the FORECAST 90 Computer Programs"
 - A "Guide to Network Construction and Utilization"

CACI and SSI worked closely throughout the contract effort and both believe that the effort was successful. It is left to the reader, after reviewing this text and after actually using the FORECAST 90 program either in the Pentagon or at the U.S. Army War College (on Honeywell 6000 series equipment), to determine just how much utility the program has for him and its potential for the future.

AN OVERVIEW OF THE MANUAL

The remaining five chapters of this manual deal with three separate but interrelated topics. Chapters 2-4 present basic guidelines for network construction, including a discussion of the components of a network and how it is constructed (Chapter 2), how the standardized code for network nodes is developed and applied (Chapter 3), and how network integration is undertaken (Chapter 4).

A second part of the manual summarizes the coverage of the existing FORECAST 90 networks on the trends, determining factors, and geographic regions. Information is also presented in Chapter 5 on the extent of network integration in the 52 trees developed by CACI. Chapter 5 concludes with a brief guide to the use of the fundamental computer program written for FORECAST 90, the NET4 program, that describes what networks are presently available, and permits the user to search for nets on specific topics or specific geographic areas that may be of interest.

A final topical theme is presented in Chapter 6 that discusses ways in which the networks might be utilized in the forecasting and planning communities. After presenting a hypothetical application of the networks to a problem, the chapter, and the manual, end with a discussion of some potential problem areas and limitations to the kind of networking used in FORECAST 90.

2. NETWORK CONSTRUCTION

This chapter begins the "how to" section of the manual in which information is given on the procedures for constructing, coding, and integrating networks written in the FORECAST 90 format. The emphasis of this chapter is on network construction, that is, how one generates a network so that it structurally matches the 52 networks constructed by CACI to meet the Strategic Studies Institute format.

The first section of the chapter presents the structure of the trees built for FORECAST 90. Since these networks have several features that distinguish them from other decision networks, attention is focused on the particular characteristics of the FORECAST 90 system. The second section of the chapter deals with the ways in which the particular components of the FORECAST 90 networks are generated. Thus, each part of a FORECAST 90 network is considered, and some guidance for developing additional networks is presented. The third and fourth parts of the chapter present the physical steps involved in network construction and an example of network construction using a particular network that was written for FORECAST 90. Emphasis is placed on the steps an analyst must take to put his ideas into the FORECAST 90 format. Some "shortcuts" the analyst might employ to cut the amount of effort in network construction are also presented.

THE STRUCTURE OF THE FORECAST 90 NETWORKS

The networks constructed under the contract phase of FORECAST 90 have eight components:

- A trend or condition (as a network starting point).
- Determining factors for each trend.
- A catalytic event that might be expected to produce discontinuities in the trends or conditions.

- A set of major activities affected by each catalytic event.
- First-order effects of the catalytic event on the trend for a specific affected activity.
- Second-order effects for the catalytic event on the trend in the specific affected activity, including the possible reaction of one actor to the activities of another.
- Third-order effects for the catalytic event on the trend in the specific affected activity, including the possible reaction of the first actor to the actions of the second actor as shown in the second-order consequence.
- An outcome for each branch in the network, scored to show whether the original trend or condition had increased (+), decreased (-), or been maintained (0) as a result of the catalytic event and the sequence that followed.

Figure 1 shows the form of the networks constructed by CACI for the FORECAST 90 project. Network analysis is generally restricted to event sequences that might plausibly be expected to occur within the 1975 to 1990 time frame. Extremely important sequences might extend past 1990. But for the most part they do not. Rather, the intent is to use the year 1990 as a device for focusing the language of each analyst on the same time period. Hence, the words used in a given network on population would say "By 1990 population growth in the United States will have slowed..." rather than, "the United States will achieve zero population growth by the year 2000."

The FORECAST 90 networks adopt a particular stance toward time. They do not forecast the occurrence of a particular event at a particular point between 1975 and 1990. Rather, they attempt to assess the downstream effects of an event that is both plausible, based on past or current information, and capable of disrupting at least one part of the relations among nations in the contemporary world arena.

Given this mission, the FORECAST 90 networks treat sequential time. In other words, time is only relevant to the FORECAST 90 networks in that

occurrences in a second-order effect follow after the first-order effect. Thus, an internal time schedule such that all first-order effects will have occurred by a particular year and all other effects will have occurred by another time point is not set.

A second aspect of sequential time in the FORECAST 90 networks is that time is set internally for each of the networks. Each network operates in its own internal time sequence and each of these sequences may be independent of all other time sequences. Thus, it is possible to think of each network as a separate and distinct attempt to consider the downstream implications of an occurrence that is potentially catalytic in its impact on the world arena.

A MORE DETAILED LOOK AT THE NETWORK REQUIREMENTS

This section of the chapter reviews and describes the components of each FORECAST 90 network in some detail. Hence, the trends, determining factors, catalytic events, affected activities, multiple-order effects and decisional outcomes are considered in separate sections.

Trend Selection

One major trend was selected for each of five areas: economic, military, political, socio-psychological, and technological. The criteria for selecting the specific trends within these guidelines was (1) relevance to U.S. strategic interests, (2) completeness of coverage of possible future trends, (3) manageability of the trend definition for networking, and (4) usefulness of the trend designation for future analysis.

Based on these considerations, and in consultations between CACI and SSI, the following five trends were defined and used for network construction.

- Economic: economic interdependence
- Military: utility of force
- Political: detente

- Socio-psychological: sense of world community
- Technological: rate of change in technology

Briefly, economic interdependence refers to the extent to which the major countries of the world are joined together through mutual economic needs and activities. Utility of force includes the extent to which capabilities and credibility of capabilities influence how force can be used as an element in the political strategies of nations. Detente involves attempts by all actors to reduce tensions and expand areas of cooperation. Sense of world community involves conditions and attitudes that influence levels of interaction and recognition of interdependence among world peoples. Finally, the rate of change in technology involves the speed with which new technologies are discovered or existing technologies are diffused from one country to another. More complete definitions for each of these trends are included in Table 1.

Determining Factors

A set of determining factors are selected for each trend chosen for networking in FORECAST 90. These determining factors are attempts to specify the trends in more detail. Thus, the trends provide an umbrella for the determining factors, and the determining factors can be considered boundaries on the trends.

It is important to emphasize that each determining factor refers directly to a single trend and not to all trends or even several trends in a particular substantive area. Table 2, which contains the determining factors for the economic trend (economic interdependence), illustrates this point. Each determining factor of economic interdependence presented in Table 2 is an attempt to specify the ways in which economic interdependence might be manifested. Thus, attention is directed to basic economic mechanisms that are central to interdependence: supply of basic resources, market availability, international financial systems, inequalities in wealth, free trade, costs of transportation, and labor mobility. Similar breakdowns for the other trends are presented in Tables 3-6.

TABLE 1
Preliminary Trends and Network Starting Points:
FORECAST 90 Project

ECONOMIC: Interdependence

Definition: The interrelationships between and among the principal world actors deriving from conditions of international trade and finance, natural resource possession (particularly energy sources, metals, chemicals and food) and demographic, technological, ecological, and military factors.

Operationalizing Element: Activity deriving from conditions of international trade and finance, natural resource possession, or demographic, technological, ecological, and military factors that increase the set of interrelationships between and among the principal world actors contributes positively to interdependence; activity that reduces that set of interrelationships contributes negatively.

MILITARY: Utility of Force

Definition:

from the existence of military force capabilities and their credibility (adversary's perception of both an opponent's force capabilities and his willingness/determination to use them) that impact on the utility of force as an element in the political strategies of nations.

Operationalizing Element: A net increase in the utility of force is considered positive; the converse is negative. The measure of the utility of force in a given situation is the ability of each country involved to project effective military force into the arena of potential conflict. More specifically, the focus is on changes in the ability of the United States to project force into a specific situation or location.

TABLE 1 (Cont'd)

POLITICAL: Detente

Definition: Those attitudes, policies, and actions of major powers reflecting the belief that their respective national interest can be best preserved and enhanced by reduction of international tension, cooperation in areas of mutual interest, and reconciliation, limitation, or control over areas of conflicting interest.

The central focus of detente is on the relationships of the United States, the Soviet Union, Western Europe, Japan, and the People's Republic of China, each with the others and in appropriate combinations. Peripheral influences are also exercised on these relationships by lesser powers by way of their particular strategic geographic location, possession of critical resources, population size, or other significant attributes.

Operationalizing Element: Any event that tends to affect, positively or negatively, the attitudes, policies, and actions of any major power toward any other power, combination of powers, or all other powers within the context of detente as defined above.

SOCIO-PSYCHOLOGICAL: Sense of World Community

Definition: The complex of social conditions, institutions, processes, and attitudes that determine levels of interaction and recognition of interdependence among the world's peoples, societies, classes, cultures, nations, and regions.

Operationalizing Element: Activity that promotes interaction among the world's peoples and recognition of interdependence makes a positive contribution to the sense of world community; activity that inhibits interaction and recognition of interdependence makes a negative contribution.

TABLE 1 (Cont'd)

TECHNOLOGICAL: Rate of Change in Technology

Definition: Technology is the application of scientific knowledge to the problems of man's existence in his environment. The rate of change of technology is the speed with which new technologies are discovered or existing technology is diffused through the international system.

Operationalizing Element: Events that augment either the rate of discovery or diffusion of technology make a positive contribution to the rate of technological change. Events that decrease the rate of discovery or diffusion of technology to levels below the current trend make a negative contribution.

TABLE 2
Determining Factors for Economic Networks

- E1. An adequate supply of basic resources to meet existing demands.
- E2. Availability of markets for established industrial/processed goods.
- E3. Stability of international monetary/financial system.
- E4. Continuation of absolute and relative inequalities in distribution of wealth.
- E5. Policies reflecting the recognition of the benefits accruing from unencumbered international trade.
- E6. Level of cost of transportation.
- E7. International labor mobility.

TABLE 3
Determining Factors for Military Networks

- M1. Relative and absolute strategic nuclear capabilities of major actors.
- M2. Balance of East-West tactical and conventional forces.
- M3. Capabilities of major powers to establish, maintain, and utilize significant bases for military operations outside their national geographic boundaries.
- M4. Percentage of gross national product (GNP)/national budget committed by major powers to the development and maintenance of military capabilities.
- M5. Extent and sources of military aid/military sales programs in less developed countries.
- M6. Development of militarily significant nuclear capability by nations not previously so equipped.

TABLE 4
Determining Factors for Political Networks

- P1. Continued progress toward global economic interpenetration.
- P2. Stability of current international alliance patterns.
- P3. A pragmatic, as opposed to ideological, orientation on the part of the leadership of the five major actors.
- P4. Absence/presence of significant conflicts in which major power national interests are directly involved on opposing sides.
- P5. Absence/presence of situations presenting significant opportunities for major actors to increase or expand influence.
- P6. Presence of mutual deterrent capability between the United States and Soviet Union.
- P7. Level of Soviet/Chinese tension.
- P8. The stability of absolute and relative nuclear weapons distribution.
- P9. Level of developed/developing/undeveloped tensions.

TABLE 5
Determining Factors for Socio-Psychological Networks

- S1. Role, scope, and influence of supranational organizations (FAO, ICAO, WHO, World Population Council).
- S2. Role, scope, and influence of regional international organizations (European Common Market, LAFTA, CACM, ASEAN, OAU, EACM, RCD, OAS, NATO, Adec group).
- S3. Continued progress toward global economic interpenetration.
- S4. Level of global social communication and transnational social interaction and exposure.
- S5. Impact of availability of resources on attitudes toward cooperation and conflict.
- S6. Impact of race, cultural, linguistic differences of attitudes toward cooperation and conflict.
- S7. Impact of ideological differences on attitudes toward cooperation and conflict.

TABLE 6
Determining Factors for Technological Networks

- T1. Availability of investment capital.
- T2. Universal belief that science and technology are key elements for advancing the quality of life.
- T3. Government support for R&D
- T4. Continued growth and adaptation of education systems.
- T5. Degree of efficiency of information exchanges.
- T6. Major social, ecological, and environmental problems providing opportunities for applying technology.

Additional determining factors will be developed as more trends are isolated for networking. If the need arises, other determining factors may be isolated for later analysis with the five existing trends. Thus, the number of determining factors reported in Tables 2-6 for any trend is not set. They can be expanded as needed for the creation of additional networks. However, the determining factors presented in these tables focused the present FORECAST 90 networks.

Identification of Plausible Catalytic Events

The identification of catalytic events is a crucial step in network construction. The operational definition utilized for catalytic events is "a specific occurrence or set of occurrences that can be expected, on the basis of theoretical or empirical literature, to create a major discontinuity in the trend under analysis." Catalytic events are logically related to the trends through the sets of determining factors--a change in one of the determining factors leads to a change in the trend under study.

Four criteria are relevant to the selection of catalytic events--theoretical completeness, manageability, usefulness of resulting analyses, and plausibility. Plausibility is an important criterion. It suggests that catalytic

events need not be likely, but cannot be justified by merely having some finite probability. Hence, there is room for imaginative analysis, but not for flights of fancy. While the number of events under analysis varies from trend to trend, a total of 52 networks were constructed. These catalytic events are listed in Appendix I.

There are at least three ways in which ideas for catalytic events can be generated. First, they might come from existing forecasting models, such as those used to generate the JLRSS (CACI, 1974b, 1975b). Here, indications of shifts in major environmental trends can be used to trigger considerations of catalytic events. For example, early projections from the JLRSS models successfully predicted domestic political instability in Portugal starting in 1974 and a movement away from NATO by Greece and Turkey starting in the mid-1970's. Each of these forecasts noted a major shift from the existing trends. Each could have been used as evidence for the generation of catalytic events for FORECAST 90.

A second way in which the catalytic events could be generated is by isolating major events that will occur, although the timing of the event is unknown. The most prominent example of this type of event is the death of a prominent political leader in a politically or economically important area. Thus, the FORECAST 90 project has consistently used the death of Tito as a catalytic event that could generate major changes in the structure of detente. While it is clear that Tito will die, there is no particularly compelling reason to expect that event to occur on one date rather than another. Similar arguments can be made for the death of almost every other major world leader.

A third way in which the catalytic events can be generated is through the disciplined imagination of a knowledgeable analyst. Here, the only limit to the analyst's imagination is that the event must be plausible, based on past experience or current trends. Once the plausibility test has been met for the event, any event that might catalytically affect the international system is a viable candidate for networking. For example, many

experts agree that a renewal of Arab-Israeli hostilities is likely at some point in the foreseeable future and plans for that contingency should be made.

Affected Activities

Affected activities refer to the focus areas within the networks. Five affected activities have been used to construct the FORECAST 90 networks.

- U.S./USSR Relations
- U.S./PRC Relations
- U.S./Japanese Relations
- U.S./Western European Relations
- U.S./Other Country Relations

Each network considers the impact of the catalytic event on the specific trend under analysis for each of these five affected activity points.

The five affected activities have been chosen for their central role in U.S. foreign relations. Clearly, if the networks are to be useful as a tool for planning and forecasting, they must include a major section on the Soviet Union and China as America's major world adversaries. Similarly, Japan must be considered as both an ally and a major trading partner for the United States. The same criteria, along with strong historical and cultural ties, argue for the inclusion of Western Europe. Finally, the countries of the Third World are lumped together as "other countries." These countries are considered jointly, or considered in more detail where appropriate (for example, the Persian Gulf states in networks dealing with an oil embargo against the industrial countries), in order to keep the networks manageable.

Multiple-Order Effects

Within each affected sphere, three rounds of effects are examined. Each node is restricted to six or fewer effects that specify an envelope of possible activities whenever possible. Thus, an attempt is made to distinguish greatest increase or decrease (from the perspective of the trend under analysis) that a country's action could cause from the previous level of the trend. Having minimally defined these upper- and lower-bound branches from a particular node, the analyst then attempts to introduce other branches that fall between these extremes that reflect plausible responses to the prior sequence of events.

In constructing these multiple-order consequences, the analyst is attempting to develop a plausible sequence of responses that a country might take to the catalytic event insofar as it impacts on the trend. Thus, at each point, the analyst tries to determine the relevant actors in this exchange how they might interact within this affected activity area, and what pattern of responses is likely. Then, differing numbers and types of response nodes are developed for each situation.

The number of branches developed between these extremes is determined on a network-by-network basis, judging from the importance of the node, the width of the extreme branches, the relevance to U.S. strategic interests, and the joint problems of completeness of the response and manageability of the task. To insure completeness, the node branches for the multiple-order consequences in the existing networks have been checked by several different CACI analysts and given to members of the faculty at the U.S. Army War College (USAWC) for evaluation. Manageability has been enhanced by restricting the number of nodes from any point to a maximum of six.

Decisional Outcomes

The end point of each combination of branches in each network is a decisional outcome. In the decisional outcome, the analyst judges whether the sequence

of occurrences that led to that point in the network would have increased, decreased or maintained the trend on which the network is based. These judgments would then be checked with at least one additional analyst who is knowledgeable about the subject matter or the region in which the catalytic event occurred.

Determining whether the trend has increased, decreased, or been maintained is not always a straightforward matter. At times, it is difficult to determine whether the sequence that has been described will actually worsen relations between two countries. At other times, it is clear that a change has been made in one set of relations (for example, relations between the United States and Japan) that is offset by an opposite change in relations in another area (for example, relations between the United States and Western Europe). Hence, for some particularly difficult cases, more elaborate coding rules have been developed to aid the analyst in determining whether the trend has increased, decreased, or been maintained.

Coding Instruction for Economic Interdependence. Two scoring criteria were employed in assessing the impact of catalytic events on economic interdependence. The first involves evaluating the overall shift or shifts in the volume of international economic interdependence. The second assesses only the number of relationships (i.e., dyads) actually linked through some interaction without considering the intensity of such interaction. In Figure 2A the dyad's volume is greater than in 2B:

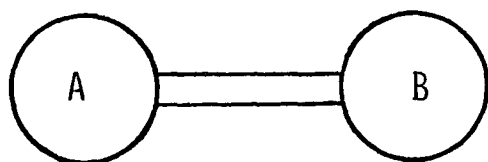


Figure 2A. Moderate Economic Interdependence for a Dyad.

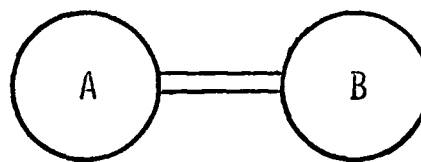


Figure 2B. Minimal Economic Interdependence for Dyad.

Another way of reasoning may also be used. We can characterize the world economy as more or less finite. This means that we begin by assuming a bounded international economic space which is that portion of the total

world economy engaged in by nations behaving toward one another. This may be represented as a rectangle whose dimensions are the level of international economic activity and the number of nation dyads engaging in that activity as in Figure 3A. The shaded area represents the volume of international economic activity engaged in by the number of dyads in the system at two points in time (t_1 and t_2). The dotted line indicates an increase in the volume of interdependence from t_1 to t_2 . Thus, in effect, this criterion is measuring, albeit intuitively, the absolute volume (level) of economic interdependence.

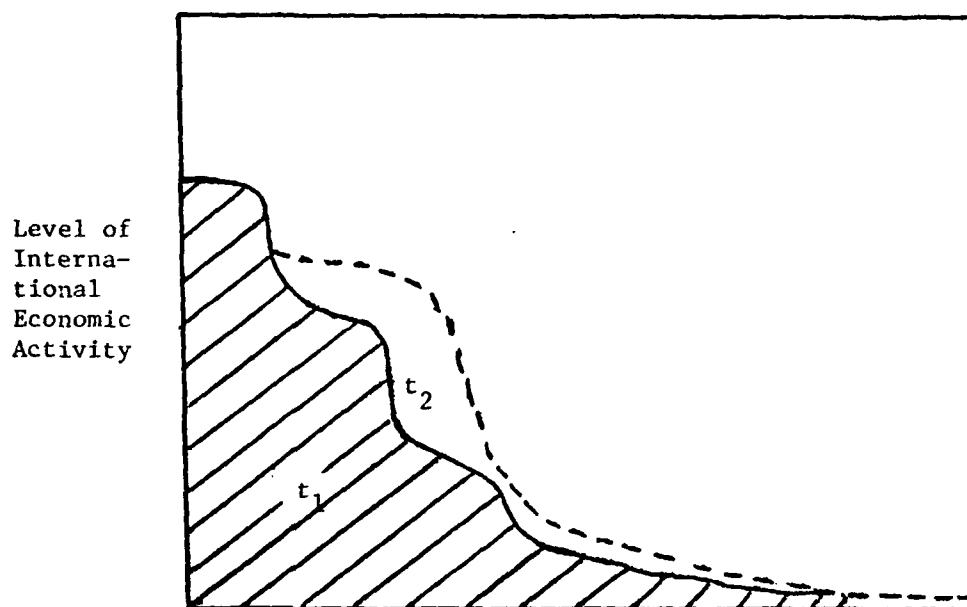


Figure 3A. Economic Interdependence Across Many Dyads.

The second criterion is involved only when the first cannot discriminate between outcomes and considers the actual number of interdependent nation dyads in the international economic system. In essence, this measure is relative since adding a new dyad actually increases the size of the bounded international economic space. Thus, the relative volume at t_1 in Figure 3B is less than it is at t_2 since the addition of one dyad increases the size of the total world economy.

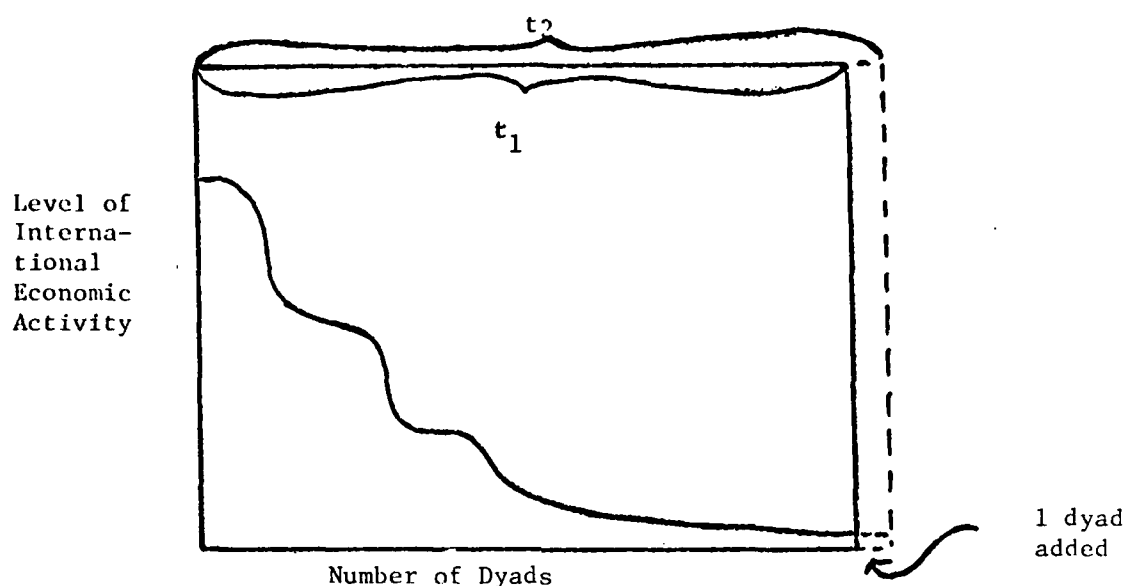


Figure 3B. The Impact of a New Dyad on Economic Interdependence

Interdependence in international economics is highly complex and concerns, at the minimum, commodity concentration, the importance of commodities, partner concentration, and the substitutability of products, goods, markets for and sources of materials. Use of the first criterion attempts to take these considerations into account when assessing the impact of events on interdependence. When the issues involved in interdependence become so clouded that assigning a value (+, -, or 0) becomes impossible, the second criterion is used. One difficulty that these criteria try to overcome is represented by Figures 4A and 4B in which the high degree of interdependence between nation A and nation B is shown. The interdependence in Figure 4A is greater than in Figure 4B where there is less interdependence and more dyads. Indeed, the situation in Figure 4B is more desirable since any

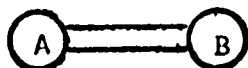


Figure 4A. Economic Interdependence in a Dyad

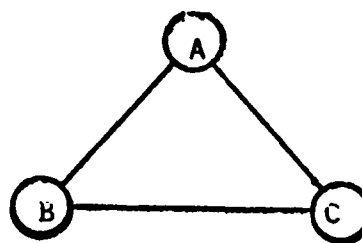


Figure 4B. Economic Interdependence in a Triad.

one nation is not dependent on any other. Changes in the volume of interdependence would be investigated and evaluated for Figure 4A and the number of relationships would be considered and evaluated in Figure 4B.

Coding Instructions for Utility of Military Force. Unlike economic interdependence or detente (which follows), utility of force is coded for the specific pair of countries in affected activities and for the specific geographic region considered in the catalytic event. Hence, for U.S./USSR relations, the utility of force is assessed as a change in the ability of the United States to project military forces in particular geographic regions of the world as one aspect of a national security policy. Where the issues did not directly involve the United States, assessment was based on whether any changes in the capacity of the United States to project force into the area resulted.

Where more than one actor is involved (for example, in Western Europe or with other countries) an assessment must be made of the change in the utility of force for the entire set of countries rather than for a specific country. Often, differential impacts will be needed that are weighed against one another. In these instances, there is no substitute for the judgment of the substantive analyst and the critical review of his peers.

Coding Instructions for Detente. As conceptualized in FORECAST 90, detente includes actions, policies, and attitudes of major powers that would improve their cooperation or reduce the level of tension among them. In practice, however, such a definition has several problems that have to be resolved before measuring the impact of changes that international events would have on "detente."

The first problem involves ranking components of detente. According to the definition, the behavioral components of detente include (1) actions, (2) policies, and (3) attitudes. These components were not ranked by the definition. Therefore, if in a given situation they moved in opposite

directions, there would be no rule for deciding which would have greater significance for detente. For instance, the Soviet Union and the United States may agree to cooperate to settle the Middle East conflict so that the conflict would not endanger detente; but the Soviet Union may then increase tensions by backing Egyptian demands completely unacceptable to Israel. That is, the Soviet policy may be to preserve detente but their actions may endanger it.

In order to avoid this conceptual problem in assessing the impact of any event on detente, the following assumption was made:

- The impact of actions takes precedence over the impact of policies and the impact of the policies takes precedence over the impact of attitudes.

This assumption is reasonable since each party involved in detente interprets the policies and attitudes of the other side on the basis of actions. Actions are the most visible indicators of attitudes and policies. Furthermore, since policies are more goal-oriented and more tangible than attitudes (and more relevant to nation-states' behavior than attitudes) their impact on detente should have precedence over attitudes.

FORECAST 90 defines detente in terms of attitudes, policies, and actions of "major powers." It does not, however, specify whether the attitudes, policies, and actions of all major powers should be given equal weight or whether certain powers deserve more attention. Common sense clearly indicates that the behavior of the United States and the Soviet Union are of far greater significance than those of militarily weak Japan or the non-unified EEC. China, with its growing military strength and huge population resources, seems to fall somewhere between these two groups. Based on these considerations, in analyzing the impact of interactions of major powers on detente, the U.S.-Soviet relationship will be considered most important for detente. The U.S.-Chinese and Soviet-Chinese relationships will be considered of secondary importance, and all other relationships between major powers will be considered of third-order importance.

Since detente implies a relaxation of tensions, it would be reasonable to focus the analyses on the relationships of those countries that have had a history of involvement on opposite sides of the Cold War. Thus the U.S.-Japanese relationship would be least important to detente because both have been on the same side in the Cold War and Japan is not a major military power.

Perceptions are extremely important in determining the impact of major power interactions on detente. It is through perceptions that powers interpret the actions of each other as legitimate or not with respect to detente. Misperceptions can sometimes wreck detente as easily as deliberate actions designed to that end. Although misperception can be very important in determining the course of detente, considering them would expand the FORECAST 90 networks to unmanageable lengths. Consequently, in constructing the networks, the possibility of misperception was only infrequently considered.

Coding Instructions for Sense of World Community. Sense of world community is operationally defined as any activity that promotes interaction among the world's peoples. Hence, recognition of interdependence makes a positive contribution to the sense of world community. Activity that inhibits the interaction and recognition of interdependence makes a negative contribution. However, interaction and recognition of interdependence may not be mutually reinforcing elements. Therefore, several points need to be emphasized in order to interpret the impact of particular events or decisions on the trend:

(1) The world is now characterized by differences. These include North/South (developed/developing country differences) East/West (capitalist/Communist or ideological differences); colonial power/former colony differences; and racial, religious, and cultural differences.

(2) Many of these differences overlap. Thus, white, Western, and developed tend to be attributes of the most powerful nations while non-white

(black or oriental), non-Western (South or East), and underdeveloped tend to be attributes of the less powerful. The sense of world community depends, in part, upon the elimination of the salience of these "differences," upon the recognition that "we're all in this together" and therefore, in spite of differences which are associated with the comparative advantages of some actors, "we must cooperate if we are to resolve problems."

(3) The recognition of interdependence ("we're all in this together") does not necessarily entail cooperation. A large body of socio-psychological literature dealing with the effects of stress on group dynamics (Broadbent, 1971; Coelho, et al., 1974; Coser, 1956; Deutsch, 1973; Janis, 1972; Sherif, 1966; Simmel, 1955), economic literature (Buchanan, 1965; Coase, 1960; Marschak and Radnor, 1972; Pauly, 1967, 1967; Samuelson, 1954), and political science literature (Downs, 1957; Ilchman and Uphoff, 1971; Olson, 1965; Smelser, 1963) suggests that in situations of scarcity or deprivation, individuals act to maximize their individual interests rather than sacrifice to achieve a general good or distribute the burden to all individuals. If we generalize from individual or group behavior to nation-state behavior, this literature suggests that, in crisis situations, nations may well recognize their interdependence but may not interact in ways that will enhance interdependence, distribute benefits, or minimize sacrifices among nations.

This problem is especially important when dealing with Third World countries. These nations are quite aware that they interact with and are interdependent with, if not dependent on, the major powers. They therefore fulfill one of the conditions of the positive sense of world community. What they strive for, however, is to be equal members of the world community, that is, to eliminate their own sense of deprivation. Given current economic and political conditions in the world -- discrepancies in national wealth, economic capacity, resources, military strength, and so forth -- it is not likely that Third World countries and lesser powers will feel equal to major powers within the next 15 years. Their current policies are to use what national strengths they have (for example,

oil; numerical strength in the United Nations; racial, ideological, and cultural solidarities) to assert themselves against the traditionally dominant power in the international sphere.

These actions reflect not only a recognition of the sense of interdependence but also a sense of inequality which has a negative influence on achieving a sense of world community. In times of crisis, particularly crises relevant to the trend, weaker states tend to fall back on their mutual differences, seeking, with combined action, the power to influence stronger nations. Strong states, similarly, may reduce their international commitments to minimize the impact of the crisis on themselves. Needless to say, the major powers also frequently attempt to use these differences to achieve their own interests, political or economic.

(4) Given the above, we must conclude that cooperation across different cleavages to solve pressing world problems requires, in most cases, the prior realization of levels of political and economic development that lessen the nation's sense of scarcity, deprivation, or inequality with respect to major powers or other privileged actors. Therefore, any event that emphasizes differences between one group of nations and another, particularly between have and have-not nations, may have a negative impact on cooperation in resolving world problems while at the same time increasing the recognition of interdependence.

(5) In coding the outcomes of trends in the socio-psychological network we have used the rule of thumb that cooperation across different cleavages has a greater impact on the sense of world community than recognition of interdependence. Cooperation by a large group of nations, even if such a group includes primarily LDC's, contributes positively to the achievement of a sense of world community. This is so, even if one or more of the major powers opposes the cooperative effort. It is also so if the major powers fall on opposite sides of policy decisions, as long as a large group of nations succeeds in cooperating with one of them. This

rule of precedence makes the outcomes of the socio-psychological networks somewhat different from those of the political networks (detente) in which major power cooperation is obligatory to achieving detente. However, if cooperation is influenced by cleavages determined by major power interactions (for example, East/West ideological cleavages) and major contending blocs are formed, a negative impact on the sense of world community is observed. Cooperation which helps minimize perceptions of deprivation or inequality, particularly between major powers and LDC's, similarly contributes more strongly to the sense of world community than does cooperation solely between the major actors. The statements in Table 7 may serve as models for coding outcomes (H-columns) in the socio-psychological networks.

TABLE 7
Some Sample Codings of Sense of World Community

<u>State of Cooperation</u>	<u>Outcome</u>
1. LDC's are united; major powers are divided but some major powers cooperate with LDC's.	(+)
2. Major powers split; LDC support divided between them (East/West cleavage).	(-)
3. Developed countries oppose LDC's (North/South cleavage).	(-)
4. LDC's united against developed countries.	(-)
5. Division between major powers and major powers and LDC's precludes cooperation.	(0)
6. Division between major powers and major powers and LDC's does not inhibit cooperation between some countries across East/West, North/South, developed/developing country cleavages, even if superpowers are inactive.	(+)

Coding Instructions for the Rate of Technology. The rate of change in technology is coded for any occurrences that accelerate or retard the extent to which technology developed in one country diffuses to another or other countries. As with the military trend (utility of force), the rate of

technology is coded separately for each region and for each specific set of countries. For example, coding with respect to US/USSR relations focuses on the extent to which actions by either party accelerate or retard the diffusion of technology from one to another or from one to a third party or parties. Thus, the trend is coded on a more limited basis than for a multiple-faceted concept such as detente.

PHYSICAL STEPS IN NETWORK CONSTRUCTION

The organizational and production details of network construction will be discussed in this section. Thus, it is in part historical--presenting a record of how the existing 52 FORECAST 90 networks were constructed at CACI--and in part expository--suggesting some procedures that might be followed to produce a better network as additional procedures are constructed at the USAWC. Finally, some conventions developed in the construction of the first set of networks that shortcut the long process of network construction will be presented.

Organization of Network Construction

The detailed nature of network construction, combined with the large number of catalytic events that were examined in the network construction phase of the FORECAST 90 contract, required careful organization and a systematic approach to ensure consistency of approach and quality work. Organization was necessary to control the project and establish authority and responsibility. A systematic process provided for circulation of ideas and careful review of the work being done.

Figure 5 shows the structure of the research effort involved in the FORECAST 90 project. The CACI project director interacted regularly with the substantive monitor at SSI and, on a less regular basis, with the Study Advisory Group and the Contracting Officer's Representative. These were the lines of responsibility through which guidance was received, reports transmitted, and the project results delivered.

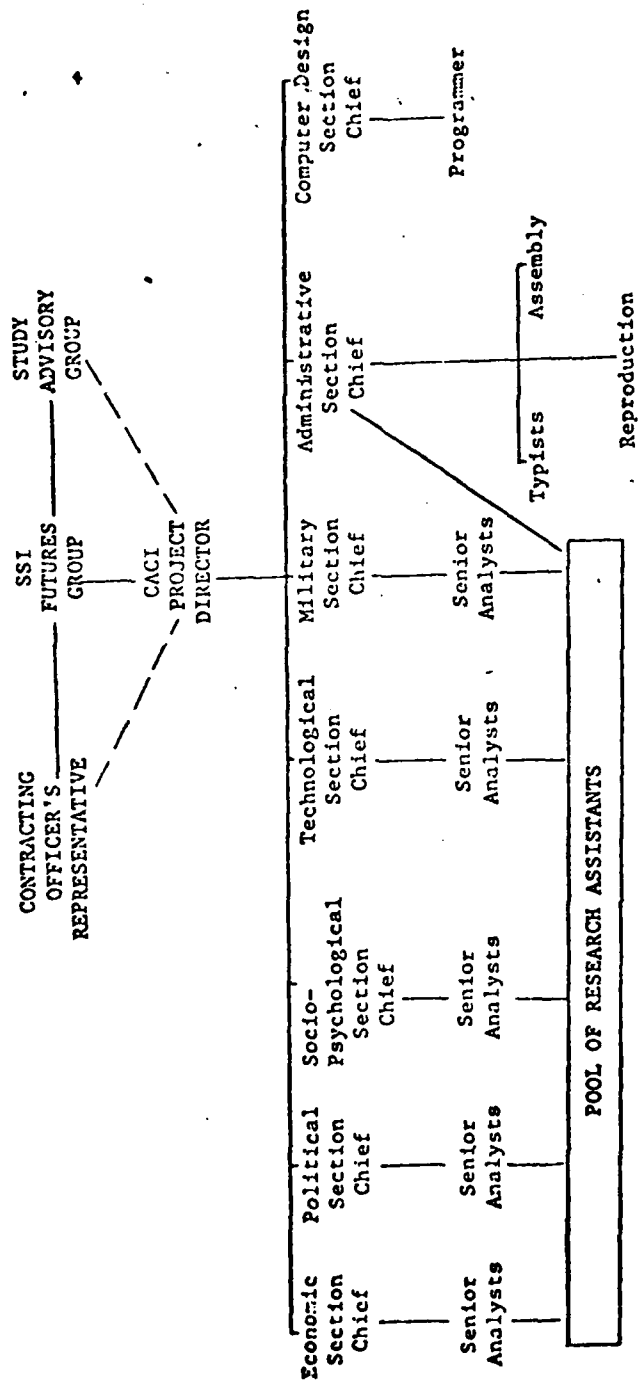


Figure 5. Structure of Research Effort.

Within CACI, the project director dealt with three different types of section chiefs--substantive area chiefs, the administrative section chief, and a computer design section chief. Meeting together, the substantive chiefs formed a "council of section chiefs" that acted as an advisory group. Each substantive section also included one or more senior (Ph.D. level) analysts. The computer design section included a junior programmer. The administrative section drew on CACI's secretarial and reproduction facilities, as well as research assistants (master's degree personnel and local area graduate students). These same research assistants were also available as support personnel for the substantive sections.

Table 8 shows the steps in network construction. The process originated in a meeting of the project director and the council of section chiefs. The first draft of a network was then written by two senior analysts (often including the section chief). This first draft consumed considerable time and involved library research as well as discussion of crucial decisions. Research assistants were employed to assist in network construction, particularly in library searches and writing detailed network notes. Once constructed, the handwritten network was passed to a senior analyst in a different substantive section. He reviewed the tree, hopefully from a somewhat different perspective than was originally utilized. Depending on the seriousness of the criticisms made, one or both of the original authors rewrote the network and passed it on to their section chief and the project director for a second review. Additional rewrites were possible, but were generally minor.

The next few steps were largely mechanical. The network was typed by a secretary, then turned over to research assistants for assembly. Typing was done on gummed labels to facilitate physical construction. The network was then checked for proper assembly and the preliminary numerical coding (covered in Chapter 3 of this manual) was inspected by another research assistant. Then, the network was xeroxed. This step usually included reduction to increase manageability. The network notes were also typed while assembly was underway.

TABLE 8
Network Construction

<u>Step</u>	<u>Personnel Involved</u>
1. Select topic	Project director, council of section chiefs
2. Research and write	Section chief plus senior analyst or two senior analysts, research assistants
3. First review	Analyst from a different section
4. Rewrite	One or two analysts
5. Second review	Section head and project director
6. Type	Typist
7. Assemble	Research assistants
8. Coding check	Research assistants
9. Reproduce	Research assistants
10. Review by War College staff and faculty	As arranged by SSI
11. Rewrite as necessary	Senior analyst or section chief
12. Review	Project director
13. Retype, assemble, code check	As required

Once copies were made, the networks were forwarded for review by personnel from SSI or other USAWC faculty members. One last rewrite was made based on the new comments. On completion of this rewrite, a final network review was made by the project director. A last round of typing, assembly, reproduction, and code checking followed. Ultimately, each network was punched on computer cards for use and storage at the USAWC.

Constructing New Networks

To write a new network, at least two initial routes can be followed. First, one can select a trend for study, pick the determining factor for the trend of interest, and then attempt to formulate a catalytic event that might enhance or disrupt the trend. Second, one can work

backward, initially formulating a catalytic event, then finding a trend and a determining factor that it might affect. The point reached, regardless of the direction, is shown in Figure 6.

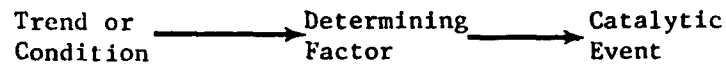


Figure 6. Initial Formulation of Network Structure.

Regardless of which way he decides to work, the next problem the author must face is how this event will affect the activities in the five areas isolated for intensive analysis in the networks (that is, U.S./USSR relations, U.S./PRC relations, U.S./Japanese relations, U.S./Western European relations, and U.S./other country relations). In some cases, the catalytic event may affect each of the areas more or less uniformly. In other cases, the catalytic event may affect all areas, but influence activities in a particular location more heavily than in others. In still other instances, the catalytic event may not affect relations in a particular location at all.

Accordingly, one of the first analytical judgments that must be made by the network's author is whether all areas will be directly affected by the catalytic event. If all are affected in some way or another, then the resulting pattern of first-, second-, and third-order effects must be considered. As noted in the earlier discussions, at each point in the designation of the multiple-order effects, the author must ask two questions.

- (1) What is the impact of the event for each of the affected activities?
- (2) What other countries might be involved in the actions taken in each of the affected activity areas?

Using this information, the author constructs an envelope of plausible reactions at each point in the network. This envelope minimally encloses the actions that will produce the greatest increase and the greatest decrease on the trend under analysis. The author also attempts to specify

other actions between these best and worst alternatives that might be taken by any of the parties involved.

In the event that the author decides that the catalytic event will have a minimal or negligible effect on the interactions between nations for particular affected activities, he merely notes this on the network as shown in Figure 7. Here, the author argues that one affected activity is not changed by the catalytic event, even though all others are. Once this position has been taken, two parts of network construction must be used.

First, the author must make an entry in the "Network Note Book" which is kept by the analysts to give some rationale on why a particular substantive decision (in this case, that one activity area was unaffected) was made. Table 9 shows an example of the format for the node (or network branching point) notes.¹

Second, the author who has decided that a specific activity area is unaffected by the catalytic event must designate this at each of the first-, second-, and third-order effect points. This can be accomplished by simply noting, as in Figure 7, that there is NO FIRST-ORDER EFFECT, NO SECOND-ORDER EFFECT, or NO THIRD-ORDER EFFECT. Thus, while other parts of the network depicted in Figure 7 branch in several directions at each of the first-, second-, and third-order effect nodes, the section of the tree that is unaffected merely contains a single line indicating at each of the multiple-order consequence points that there has not been any impact.

Any point in the process of network construction where the author thinks there will not be another higher order effect he should enter no first-, second-, or third order effect onto the network.² Where there may be some higher order effect, the author should be prepared to defend his position

¹ The network notes are entered by node number. The procedures for constructing numbers for each node are discussed in Chapter 3 of this manual.

² Network notes are entered by placing a capital "N" in parentheses with the node.

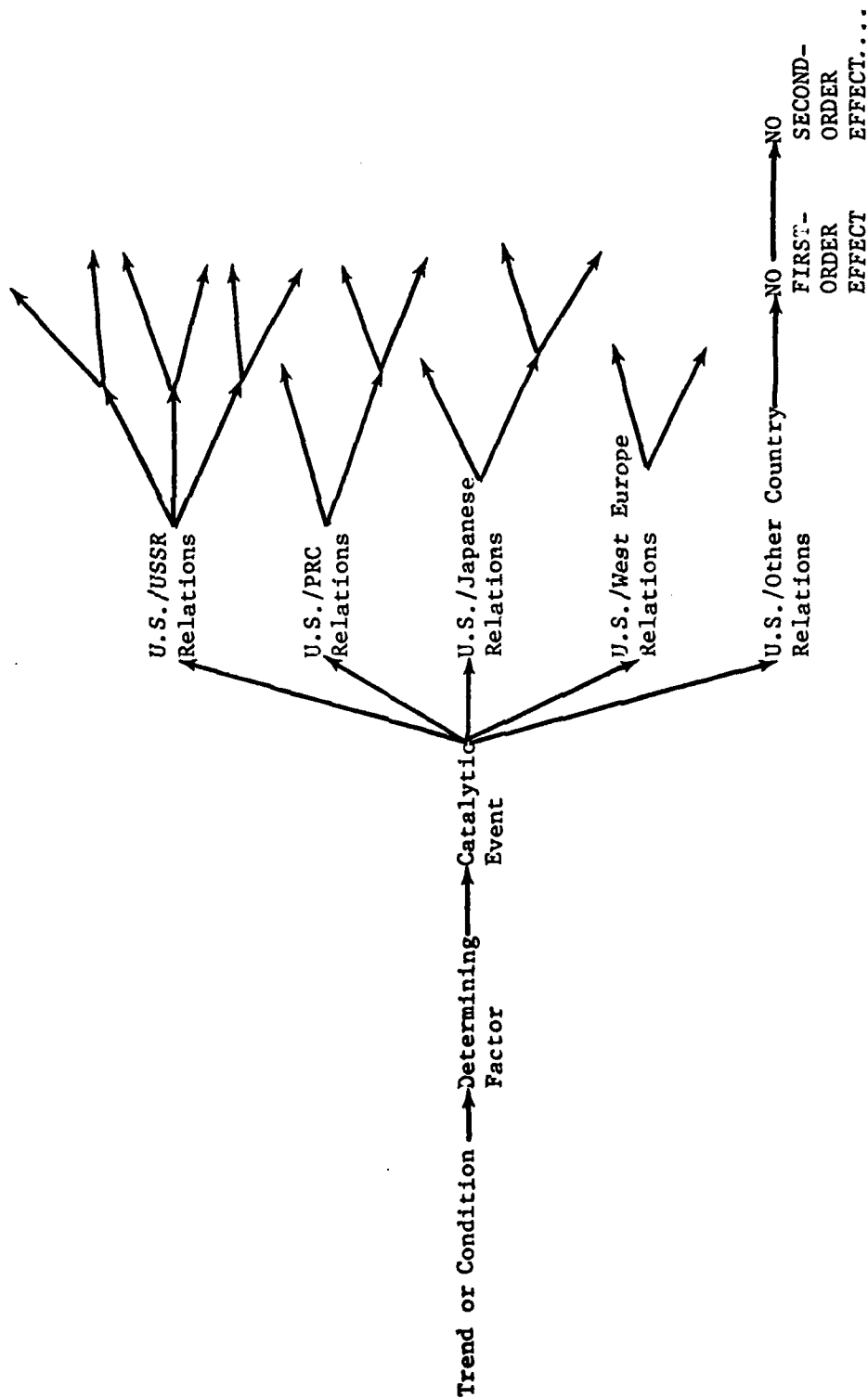


Figure 7. Network Structure for the Affected Areas

TABLE 9

Sample Network Notes for an Economic Network on an Oil Embargo

Node: E01010111

During the "October war," despite typical verbal exchanges between the United States and the Soviet Union, economic relations remained virtually undisturbed. The joint interests seem to have played a role in maintaining established linkages. As time passes, the already established economic interdependencies may grow or simply stabilize at current levels. Thus it is probable that no major disruptions would occur in the context of an Arab oil embargo.

It is doubtful whether the United States would seek Russian oil to maintain its economic viability. The Soviet Union is currently an exported of oil to East and West Europe. However, the amount it exports is small and decreasing as industrial growth takes place in the Soviet Union. It is forecast that within the next 5-10 years the Soviet Union will cease exporting oil because of the increase in domestic oil consumption.

Node: E01010121

If the United States and the Soviet Union are pitted against one another as a result of their alignments in a Mideast war, conceivably their economic relations could deteriorate. For example, should the United States perceive the international economic status quo as a necessary condition for detente, the failure of the Soviet Union to influence the Arabs with respect to their oil policies might produce a reaction in the United States. The disruption of the international economic order which is virtually assured by an oil embargo might be avoided by Soviet influence should the Soviets view this as detrimental to their interests. Also, the Soviet Union may choose to ignore the situation for political reasons (that is, to attempt to demonstrate the vulnerability of capitalistic systems.) Whatever the interpretation, failure of the Soviet Union to influence the situation might cause a negative U.S. reaction and result in a decline or suspension of existing economic activity.

by making an entry in the "Network Note Book" as indicated earlier. This and one other convention form two central norms for network construction.

- Use the "Network Note Book" to justify all questionable judgments.
- Make sure that each affected activity has an entry at each higher order consequence, even if it only announces that there is no higher effect present in that network.

Once the impact of the catalytic event on the trend for the specified affected activities has been played through the multiple-order consequences, the author must judge whether the trend has been increased, decreased, or maintained. If the trend--for example, detente--has been increased by the particular sequence, the author enters a statement that (+) DETENTE IS INCREASED. If the trend has been diminished, the entry is (-) DETENTE IS DECREASED. Finally, where the trend remains unchanged, the author enters (0) DETENTE IS MAINTAINED.

The designation that the trend has increased, decreased, or been maintained is an analytical judgment made by the author of the network based on his knowledge of the subject matter under examination. Since it is a subjective judgment, it is vital that this position, and all other positions of a similar type in the networks, be subjected to critical review by peers. It cannot be stressed too strongly that all networks should be reviewed by at least one person other than the author.

Moreover, to aid critical review and growth in the area considered in the network, the author should develop a bibliography of items consulted to construct the network. The bibliography should include items that are immediately relevant to the question and that may provide a background for someone who might consult the network and who also wishes to learn more about the subject matter.

Some Shortcuts in Network Construction

Since the process of network construction is often long and tedious, ways have been developed to shorten the effort. Three important shortcuts have been developed by CACI analysts in conjunction with the substantive monitor at SSI to shorten the process of network construction. The three are presented and discussed in this section.

- Omitted higher order consequences
- GO TO/SAME AS convention
- A priori estimates of branch likelihood

Omitted Higher Order Emergencies. Reducing the effort required for network construction by noting that there is no first-, second-, or third-order effect has already been mentioned. It is considered again under the shortcuts to network construction to suggest that careful attention to whether a particular catalytic event really would change things in the world arena can substantially reduce the size and the time required to construct the network. Hence, if there is no reason to expect a particular event to impact on a specific affected area, the notation of "no effect" should be entered. Moreover, if a particular branch of a network within an affected area (rather than the entire affected area itself) does not have a higher order effect, this fact should be noted.

Three constraints are encountered in the use of a "no effect" designation in network construction. As already noted, one must justify the assertion that there is no first-, second-, or third-order effect with a node note. Second, each network branch -- even if only composed of "no effect" nodes -- must have an outcome associated with it. Third, nothing other than additional "no effect" nodes can sequentially follow the occurrence of another "no effect" node at a particular point in the branch. In other words, if a network branch does not have a first-order effect, the network cannot then suddenly have a second- or third-order effect for the same branch.

GO TO/SAME AS Convention. A second way to shorten the size of the network and the time required to create a network is through the GO TO/SAME AS command. Briefly, where one section of a network is repeated substantially in a network, a command has been developed to permit the analyst to reference the earlier occurrence by noting that the activities in that node are the "same as" those in the other node and that reader should "go to" the other node to follow the sequence. In the 52 networks developed by CACI for FORECAST 90, "GO TO" statements were placed at each first-, second-, or third-order effect node that referred to another node with the same information. Similarly, the "SAME AS" command was used in the decisional outcome column to indicate that the impact on the trend was the same as that found elsewhere in the network.

Consider the following example. One of the FORECAST 90 networks studied the possible downstream effects on an Iranian-Iraqi war on detente. At one point in the U.S./other country relations affected activity, the following sequence occurred. As the first-order effect, the Arab countries demanded an immediate Iranian withdrawal from Iraq. Iran had two second-order options in the network: (1) warn other countries from getting involved in the dispute; (2) warn other countries that it would treat outside involvement as aggression.

Syria, one of the states that had been criticizing Iran, responded to the third-order effect with a promise to aid Iraq or directly enter Iraq with forces. Each of these options had been presented previously as a first-order effect. Thus the analyst merely directed the reader to go to the other first-order effect and continue the network from that point. At the same time, he entered a statement in the outcome column that the impact on detente was the SAME AS that found in the outcome column ultimately created for the sequence that the reader was to GO TO. In each instance, the particular node to which the transfer or the comparison was to be made was noted by its unique code number (which will be discussed in Chapter 3).

A Priori Estimates of Branch Likelihood. A third means to reduce the size of the network, and thus the time required to construct it, is to decrease the number of possible alternative branches that must be written by eliminating some as implausible or less likely to occur. Figure 8 presents an example of this procedure.

In this example, an analyst considered the plausible responses that OPEC could make to a breakthrough in fusion technology by the United States that would make it less dependent on imported petroleum. OPEC had several basic strategies at the outset. It could increase, maintain, or decrease oil prices. It could also threaten or not threaten an embargo. Finally, it could do nothing in response to the U.S. technological breakthrough, petition the United States not to release the technology to other countries, or impose sanctions against the United States if it did release the technology. As Figure 8 shows, the analyst had developed 18 different responses that OPEC could make, ranging from increasing the price of crude oil, threatening an embargo and doing nothing about American efforts to diffuse the technological breakthrough to other states, to decreasing the price of oil, not using an embargo, but imposing sanctions on the United States if it released the new technology.

A network that had this many options merely for one part of the tree-- that is, U.S./other country relations--would be extremely laborious to develop and even more difficult to utilize since it would involve 18 first-order effects merely for a single part of the network. Thus, the analyst considered combinations that were more or less likely. At each point, the branches were expressed as decimal proportions of 1.00. These decimals (actually, subjective probabilities) were then multiplied across the alternatives to generate the combined probabilities shown in parentheses in the next to the last column on the right in Figure 8. For example, the occurrence of an increase in the price of crude oil (.45), a threat of an embargo (.30), and a decision to do nothing against the U.S. technology diffusion (.60) produced a joint probability of .081 (that is, $.45 \times .30 \times .60 = .081$). Once these probabilities were computed for each of the 18 combinations, the resulting probabilities were ranked (as

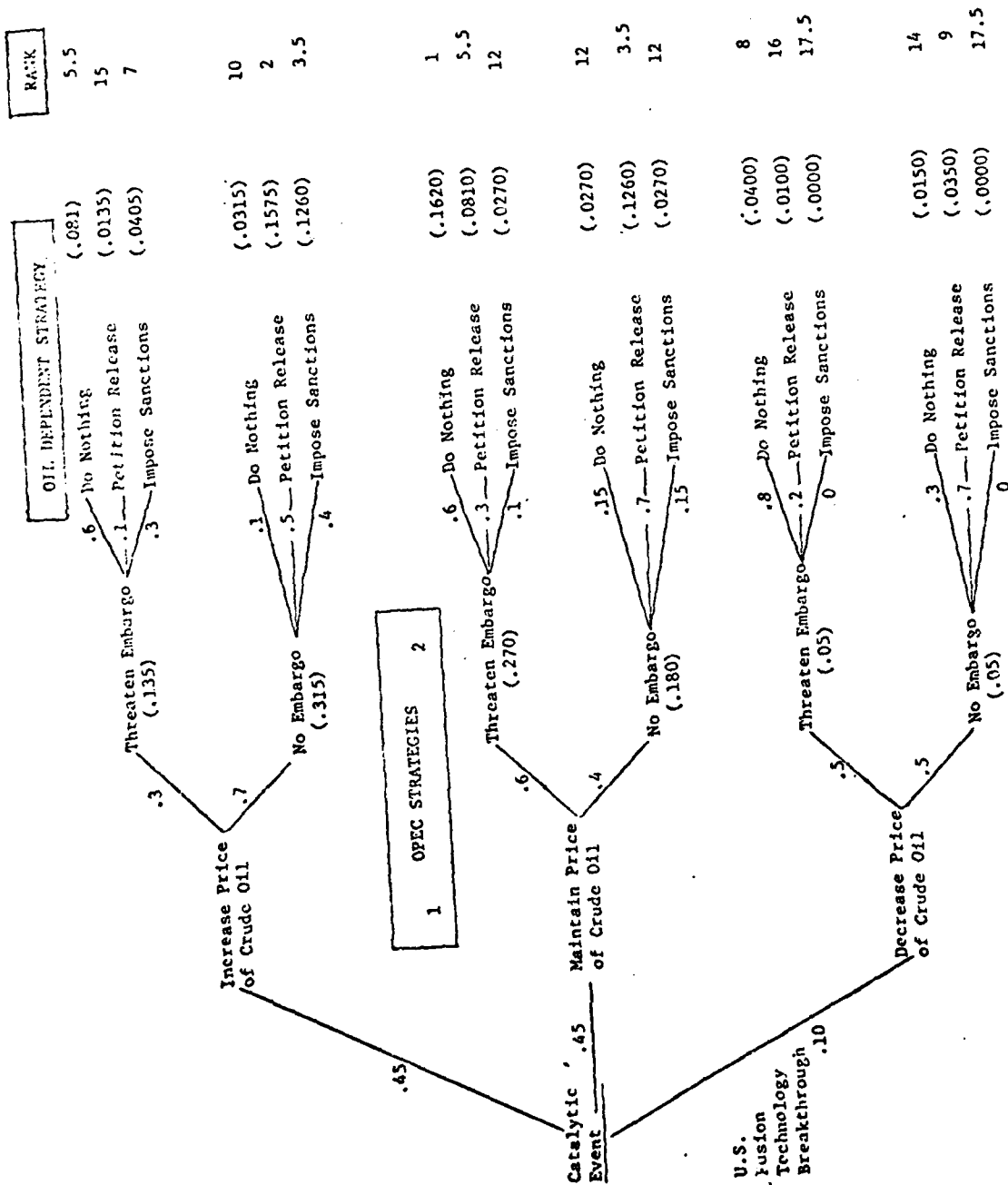


Figure 8. Decision Tree Subjective Probabilities Relating to 18 Possible Outcomes Among Three Strategies.

shown in the last column on the right) and the first 6 were chosen for networking. So that the task could remain manageable, the remaining 12 combinations were not networked.

The procedures involved required the network writer to lay out the factors that the country might consider in reaching its decisions so that these can be evaluated in terms of some estimates of more or less probable occurrences. Using these estimates, the larger number of possible alternatives could be reduced to a more manageable number.

A BRIEF ILLUSTRATION

Figures 9 and 10 show a section of a network on an Iranian-Iraqi war. As Figure 9 shows, the war starts over the Kurds, and is to be examined for the detente trend and the determining factor of the absence/presence of situations presenting major actors with significant opportunities to expand their influence. Figure 9 ends with the designation of the five affected activities.

Figure 10 presents the section of the network developed for the U.S./other country relations. Here, the analyst isolated three plausible first-order effects. The Arabs could demand an immediate Iranian withdrawal. The Syrians and others could promise aid to Iraq. The Syrians could enter Iraq to support the Iraqi forces engaged against the Iranians.

Depending on which of these initial avenues is selected, there are different second-order effects. Thus, as noted in the earlier discussion of the GO TO/SAME AS option, Iran might respond to the Arab demands by issuing another general warning about countries getting involved in local disputes or threatening other countries that got involved as aggressors. If Iran warned the other countries, the Syrians (who were already considering aid to Iraq in the other first-order effects) might send aid. Alternatively, they might commit forces to support the Iraqis. In each case, the movement of the network is referred to an earlier point in the

US/USSR RELATIONS.

US/PRC RELATIONS.

US/JAPAN RELATIONS.

US/WEST EUROPE RELATIONS.

US/OTHER COUNTRY RELATIONS.

DETENTE.

ABSENCE/PRESENCE OF SITUATIONS
PRESENTING SIGNIFICANT OPPORTU-
NITIES FOR MAJOR ACTORS TO IN-
CREASE OR EXPAND INFLUENCE.

IRAN-IRAQ WAR. IRANIAN ARMED
FORCES CROSS OVER INTO IRAQI
KURDISTAN TO SAVE THE PESH MERGA
(KURDISH GUERRILLAS) FROM TOTAL
DEFEAT. IRAQ ACCUSES THE U.S.,
IRAN AND ISRAEL OF HAVING INVAD-
ED IT AND ASKS USSR AND THE ARAB
LEAGUE COUNTRIES FOR MILITARY
SUPPORT.

Figure 9. Coding a Sample Tree from Trends to Affected Activities.

ARAB COUNTRIES DEMAND AN IMMEDIATE WITHDRAWAL OF IRANIAN FORCES FROM IRAQ.	IRAN WARNS ALL COUNTRIES AGAINST GETTING INVOLVED IN A LOCAL DISPUTE.	SYRIA PROMISES MILITARY AID TO IRAQ. GO TO PO1050152.	SAME AS PO105015221.H027 THROUGH PO105015321.H029
SYRIA, SOUTHERN YEMEN AND LIBYA PROMISE MILITARY AID TO IRAQ.	ISRAEL MOBILIZES ITS ARMED FORCES TO PREVENT SYRIAN FORCES FROM JOINING IRAQ. GO TO PO10401.	SYRIAN FORCES ENTER IRAQ TO SUPPORT IRAQI FORCES. GO TO PO1050153.	SAME AS PO105015311.H030 THROUGH PO105015321.H031
US/OTHER COUNTRY RELATIONS.	IRAN WARNS SYRIA AND LIBYA THAT IRANIAN ARMED FORCES COULD PURSUE ANY ATTACKER TO WHEREVER THEY CAME FROM.	NO THIRD-ORDER EFFECT.	(-)DETENTE DECREASED. THE ESCALATION OF CONFLICT INCREASES THE LIKELIHOOD OF CONFLICT AMONG MAJOR POWERS.
SYRIAN FORCES ENTER IRAQ TO SUPPORT IRAQI FORCES FIGHTING FOR THE CONTROL OF KIRKUK.	IRANIAN FORCES CUT THE IRAQ-SYRIAN OIL PIPELINE IN RETALIATION FOR THE SYRIAN INTERVENTION.	SYRIA ACCUSES IRAN AND ISRAEL OF COLLUDING TO TAKE OVER ARAB OIL-FIELDS AND ASKS FOR ARAB AID.	(-)DETENTE IS DECREASED. THE ISRAELI MOBILIZATION ENDANGERS DETENTE.
	ISRAELI FORCES ATTACK SYRIA. GO TO PO10401.	NO THIRD-ORDER EFFECT.	(-)DETENTE IS DECREASED. THE ESCALATION OF CONFLICT DECREASES DETENTE.
		NO THIRD-ORDER EFFECT.	(-)DETENTE IS DECREASED. IRAN'S ACTIONS INCREASE THE DANGER OF MAJOR POWER INVOLVEMENT.
		NO THIRD-ORDER EFFECT.	(-)DETENTE IS DECREASED. THE LIKELIHOOD OF USSR AND US INVOLVEMENT BECOMES VERY HIGH

Figure 10. Coding a Sample Tree from First-Order Effect to Decisional Outcomes.

tree in which a more explicit statement of the Syrian actions is presented. Thus, both third-order effects end with GO TO statements directing the reader to another location in the network. Each branch, however, ends with the decisional outcome column in which the impact of the sequence on the trend is assessed.

SUMMARY

This chapter is the first of three presenting the mechanics of network construction, coding, and integration. Network construction, treated in this chapter, is discussed as a combination of the structure of the SSI networks with the author's knowledge of a particular subject matter and his judgments about the plausibility of certain types of occurrences in specific affected areas. After some general comments on network construction, three shortcuts to network construction were considered. Finally, the chapter ended with a brief illustration of network construction using one of the 52 networks developed in the contract phase of FORECAST 90.

3. CODING THE NETWORKS

Once a specific catalytic event has been networked, the analyst must begin to code the sequence he has just constructed. Network coding is undertaken to convert the trees to a common structure so that each section in each network can be identified across the trees. Second, the application of a standardized network coding procedure enables the analyst to check the logical and structural consistency of the network. Finally, standardized network coding is required for the successful operation of the computer programs that have been written to store, retrieve, and print out the networks. The programs operate by looking for specific numbers in specific locations. Hence, these code numbers and locations must be standardized across all networks.

This chapter presents the structure of the coding system that has been developed for and applied to the 52 existing FORECAST 90 networks. The first part of the chapter details the structure and application of the code to each of the eight parts of the networks. The second section of the chapter details some additional coding conventions that are necessary to place additional networks into the format required by the FORECAST 90 computer programs. Finally, the chapter ends with an application of the coding rules to the sample network on an Iranian-Iraqi war that was developed in Chapter 2.

STRUCTURE OF THE NETWORK CODING SCHEME

A standardized, machine-readable code has been created and applied across all networks presented to the Strategic Studies Institute in the FORECAST 90 effort. The code is general enough to accommodate the contents of networks on different substantive topics in the same format. The code, which consists of an alphabetic and numeric series ranging up to 15 spaces in length, is recorded for each entry in the networks. This section describes the structure of the coding system.

Each part of the structure of the network that was presented in Chapter 2 of this manual is coded separately. In other words, there are codes that designate the trend, the determining factor, the catalytic event, the first-, second-, and third-order effects, and the decisional outcomes. Each is discussed in turn.

The Trend Under Analysis

The code provides for a three-column entry to designate the trend that is being examined. The first column of this code is a single capital letter that is used to designate the general substantive thrust of the network. For the networks that have been developed in FORECAST 90, the following letters have been used to denote the topical area of the decision tree.

- E = Economic networks
- M = Military networks
- P = Political networks
- S = Socio-psychological networks
- T = Technological networks

Additional subject areas under which trends might be grouped can be developed using this method. Similarly, these broad areas could be modified to create more discrete groupings of subject matter as needed in later network construction. Two constraints are posed by the coding system. First, the designation for all networks in a particular subject area must be consistent and unique. Once a subject area is identified, all networks that fall into that subject area must be labeled with the same character and only those in that subject area must be so labeled. Second, the characters chosen must be machine-readable. In other words, they must be characters that can be keypunched so that they can be read by the computer programs developed for FORECAST 90.

After the alphabetic character that designates the subject area of the trend has been entered, the next two columns designate the trend within

that subject area. Each trend has a unique two-digit numeric designation. The first trend in a particular subject area is designated 01, the second 02, and so forth. When combined with the character that designates the subject area, a unique sequence is created so that the first trend in the political networks (P01) can be distinguished from the first trend in the economic networks (E01).

As noted in the discussion of trend selection for the networks that have been developed to date (Chapter 2), a single trend has been chosen for each of the five general areas. Hence, for each of the substantive areas, the trend in the present networks is numbered 01 as the first trend in that area. As additional trends in each of the areas are isolated for analysis, they will be incorporated into the code. The substantive areas chosen for networking, the trend selected for each of these areas, and the network code designation for these two pieces of information are designated in Table 1.

TABLE 1
Subject Areas and Trends for FORECAST 90

<u>Subject Area</u>	<u>Trend</u>	<u>Code Designation</u>
Economic	Economic Interdependence	E01
Military	Utility of Force	M01
Political	Detente	P01
Socio-Psychological	Sense of World Community	S01
Technological	Rate of Change in Technology	T01

Determining Factors

The determining factors are coded (1) in reference to a subject area (for example, economic, military, political) and (2) a trend within that subject area (for example, economic interdependence in economic; detente in political). Thus, each determining factor developed for a specific

trend is assigned a two-digit number to distinguish it from other determining factors covered under the same trend. The code for the determining factors, which begins with 01 for the first determining factor for that trend, follows the one-letter and two-digit identification for the subject area and the trend. Hence, the code P0101 designates the first determining factor for the first trend in the political networks.

The code numbers for the existing determining factors in each of the trends are presented in Tables 2-6. These determining factors have been employed to focus the existing FORECAST 90 networks. Additional determining factors can be added for each trend. Once a second trend is isolated within a single subject area (that is, something in addition to detente in the political subject area), determining factors specific to that trend must be isolated and numbered sequentially from 01 upward. In this, the numbering of the determining factors is specific to the subject area for which they have been isolated and to the trend that they are thought to disaggregate. As presently constituted, the code can accommodate up to 100 such determining factors for each trend of the subject areas.

TABLE 2
Determining Factors for Economic Interdependence

- 01 An adequate supply of basic resources to meet existing demands.
- 02 Availability of markets for established industrial/processed goods.
- 03 Stability of international monetary/financial system.
- 04 Continuation of absolute and relative inequalities in distribution of wealth.
- 05 Policies reflecting the recognition of the benefits accruing from unencumbered international trade.
- 06 Level of cost of transportation.
- 07 International labor mobility

TABLE 3

Determining Factors for Utility of Force

- 01 Relative and absolute strategic nuclear capabilities of major actors.
- 02 Balance of East-West tactical and conventional forces.
- 03 Capabilities of major powers to establish, maintain, and utilize significant bases for military operations outside of their national geographic boundaries.
- 04 Percentage of gross national product (GNP)/national budget committed by major powers to the development and maintenance of military capabilities.
- 05 Extent and sources of military aid/military sales programs in less developed countries.
- 06 Development of militarily significant nuclear capability by nations not previously so equipped.

TABLE 4

Determining Factors for Detente

- 01 Continued progress toward global economic interpenetration.
- 02 Stability of current international alliance patterns.
- 03 A pragmatic, as opposed to ideological, orientation by the leadership of the five major actors.
- 04 Absence/presence of significant conflicts in which major power national interests are directly involved on opposing sides.
- 05 Absence/presence of situations presenting significant opportunities for major actors to increase or expand influence.
- 06 Presence of mutual deterrent capability between the United States and the Soviet Union.
- 07 Level of Soviet/Chinese tension.
- 08 The stability of absolute and relative nuclear weapons distribution.
- 09 Level of developed/developing/undeveloped tensions.

TABLE 5

Determining Factors for Sense of World Community

- 01 Role, scope, and influence of supranational organizations (FAO, ICAO, WHO, World Population Council).
- 02 Role, scope, and influence of regional international organizations (European Common Market, LAFTA, CACM, ASEAN, OECD, OAU, EACM, RCD, OAS, NATO, Adec group).
- 03 Continued progress toward global economic interpenetration.
- 04 Level of global social communication and transnational social interaction and exposure.
- 05 Impact of availability of resources on attitudes toward cooperation and conflict.
- 06 Impact of race, cultural, linguistic differences of attitudes toward cooperation and conflict.
- 07 Impact of ideological differences on attitudes toward cooperation and conflict.

TABLE 6

Determining Factors for Rate of Change in Technology

- 01 Availability of investment capital.
- 02 Universal belief that science and technology are key elements for advancing the quality of life.
- 03 Government support for R&D
- 04 Continued growth and adaptation of educational systems.
- 05 Degree of efficiency of information exchange.
- 06 Major social, ecological, and environmental problems providing opportunities for applying technology.
- 07 Growth of scientific knowledge.

The Catalytic Event

Each network portrays the impact of a single catalytic event on one trend and one determining factor for a trend. Hence, each catalytic event must be given a unique number. Once chosen for networking, the catalytic event is assigned a two-digit number that is placed directly behind the previous five-digit alphabetic-numeric combination that designates the subject area, trend, and determining factor. Since the catalytic event is networked for a specific determining factor and a specific trend, each is numbered sequentially from the first (01) onward. Thus, the network code sequence P010101 refers (reading from right to left) to the first catalytic event networked for the first determining factor of the first trend in the political subject area. The full list of catalytic events included in the 52 FORECAST 90 networks, together with their existing code numbers, is given in Appendix I. Table 7 gives an example of five of these catalytic events.

TABLE 7
Examples of Catalytic Events Used in FORECAST 90

<u>Code Number</u>	<u>Catalytic Event</u>
E010102	A 25 percent shortfall in North American grain and soy bean crops leads to a U.S. embargo on grain and soy bean exports.
M010301	The United States loses all bases and air transit rights in Southern Europe and the Middle East.
P010801	Japan decides to expand its armaments, acquire nuclear capacity, and enter the lucrative arms export market.
S010501	There is a disastrous famine in India. Starvation intensifies concern over food resource availability throughout the world.
T010202	A commercial nuclear power plant in Europe explodes, killing several hundred immediately and exposing more to varying amounts of radiation.

Affected Activities

Each set of relations that has been stipulated for analysis in FORECAST 90 has been given a unique number that is added to the previous series of alphabetic and numeric characters and applied in the same order to each network. These numbers, used in each network, are as follows.

- | | |
|-----------------------------------|----------|
| • U.S./USSR Relations | Code = 1 |
| • U.S./PRC Relations | Code = 2 |
| • U.S./Japanese Relations | Code = 3 |
| • U.S./Western European Relations | Code = 4 |
| • U.S./Other Country Relations | Code = 5 |

A single digit is added to the end of the seven-character and digit series generated for the trend, determining factor, and catalytic event to designate the affected activities for each of the networks. In this way, the occurrence of a number "1" as the eighth number in any code always refers to the part of the network that deals with U.S./USSR relations. For example, the code sequence P0101015 refers to the section of the network dealing with U.S./other country relations that might be affected by the particular event that has been networked as the first event for the first determining factor for the first political trend.

For the first eight letters or digits in the code there will be one and only one entry for each part of the networks. All of the networks deal with one trend at a time, one determining factor, one catalytic event and five affected areas. Hence, every network should have code entries that are structurally similar to those presented in Figure 1. Under no conditions will any network have more entries or fewer entries than these to code for the first segment of any network.

After the numbering of the affected areas, however, the number of entries will vary for each network. Hence, particular attention should be directed

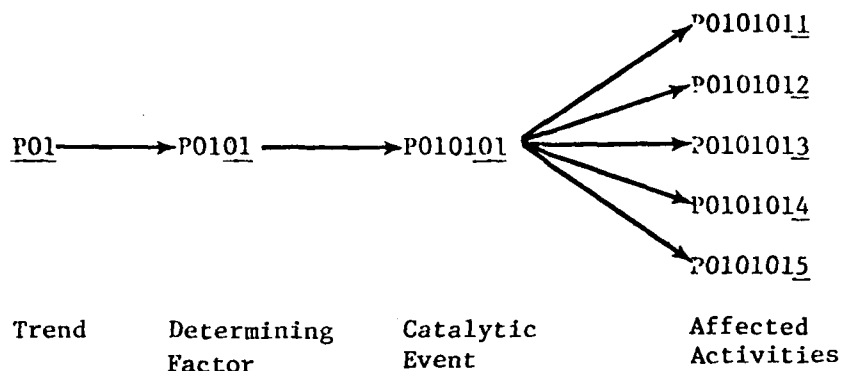


Figure 1. An Example of the Network Coding System from Trend to Affected Activities.

toward the procedures for coding networks for the first-, second-, and third-order effects, and for coding the decisional outcomes.

First-Order Effects

A single number is assigned to each first-order effect as it occurs. This designation is made in reference to each of the affected areas. Thus, the initial first-order effect of a catalytic event for relations between the United States and the Soviet Union is assigned the single digit "1." The second first-order effect is assigned "2," and so forth. This single digit is entered as each first-order effect occurs in each affected area. There will always be a first-order effect for each of the five affected areas (that is, U.S./USSR relations, U.S./PRC relations). However, there may be more than one first-order effect for each of these five affected areas. For example, the following numbers--P01010111, P01010112, P01010113--refer, respectively, to (1) the initial first-order effect developed for U.S./USSR relations for the first catalytic event networked for the first determining factor in the first political trend; (2) the second first-order effect developed for this sequence; and (3) the third first-order effect developed for this sequence.

Up to six first-order effects can be developed for any affected area. It is important to note that (1) the first-order effects are numbered in

sequential digits starting with "1" and (2) that the numbers are assigned in reference to a specific affected area. This number is added to the end of the eight-character alphabetic and numeric sequence that has preceded it.

Second-Order Effects

The second-order effects are treated in the same manner as the first-order effects except that they are coded with reference to a particular first-order effect. In each case, a single digit is assigned to the previous alphabetic-numeric series to create the tenth character entered in the sequence. Thus, the number P010101111 refers, from right to left, to (1) the first second-order effect of (2) the initial first-order effect for (3) the first catalytic event in (4) the first determining factor of (5) the first political trend. Similarly, the code number P010101112 refers to the second second-order effect that is encountered for the initial first-order effect in the network.

There can be up to six second-order effects for any given first-order effect. Each second-order effect is numbered sequentially to refer to a specific first-order effect. Each adds a single digit to the end of the existing code sequence of one letter and eight numbers.

Third-Order Effects

The third-order effect is numbered with a single digit that is placed after the digit that marks the second-order effect. Again, a third-order effect is depicted in reference to a second-order effect. All third-order effects are numbered sequentially for a specific second-order effect so that the first encountered is numbered "1," the second "2," and so forth. For example, the number P0101011112 refers, from right to left, to (1) the second third-order effect of (2) the first second-order effect for (3) the initial first-order effect given (4) to the first catalytic event networked for (5) the first determining factor in (6) the first trend in the political network.

There can be up to six third-order effects for each second-order effect. Each is to be numbered consecutively for a specific second-order effect, and only for that particular second-order effect. As with all other entries in the code, the single digit entry is placed immediately after all existing codes to create a single number for each of the third-order effects.

Decisional Outcomes

The final code entry is an alphabetic-numeric combination to designate the decision column and the number of the decision reached. A typical entry is labeled H001--that is, the first decisional outcome in a particular decision tree. This entry is added to the previous series to create the last part of the full 15-character alphabetic-numeric sequence such as P0101011111H001. Reading from right to left, this sequence decomposes to the first decisional outcome resulting from: (1) the first of the third-order effects; (2) the first of the second-order effects; (3) the initial first-order effect; (4) the first catalytic event; (5) the first determining factor; (6) for the first political trend.

The same coding procedure is used for all outcomes in all networks except where one network outcome refers to another outcome within the same network. In these cases, the entry to designate an outcome is merely the letter H. The following two examples illustrate this point.

P0101011111H001
(+) Detente is increased.

P0101015111H
Same as P0101011111H001.

Where the outcome identified at the end of the multiple-effect sequence is distinctive enough that the impact of the sequence of events on the trend is assessed (by suggesting that the trend is either increased, decreased, or maintained), then a three-digit number is added after the H to designate which outcome this is in the present network. Where the outcome refers to another outcome, as is the case in the second example, then only the H is added since the outcome to the sequence is not distinguishable from another outcome sequence. This result will be obtained

as the end product of the GO TO/SAME AS convention that was introduced in Chapter 2 to help shorten network construction and coding.

The rules for coding the outcome column can be summarized as follows:

- If the outcome summarizes a distinctive sequence of effects, it is coded with the letter H and a three-digit number ranging from 001 upward in order of occurrence in the network.
- If the outcome refers to another outcome in the same network through the GO TO/SAME AS convention, it is coded only with the letter H. No number is assigned to the outcome.

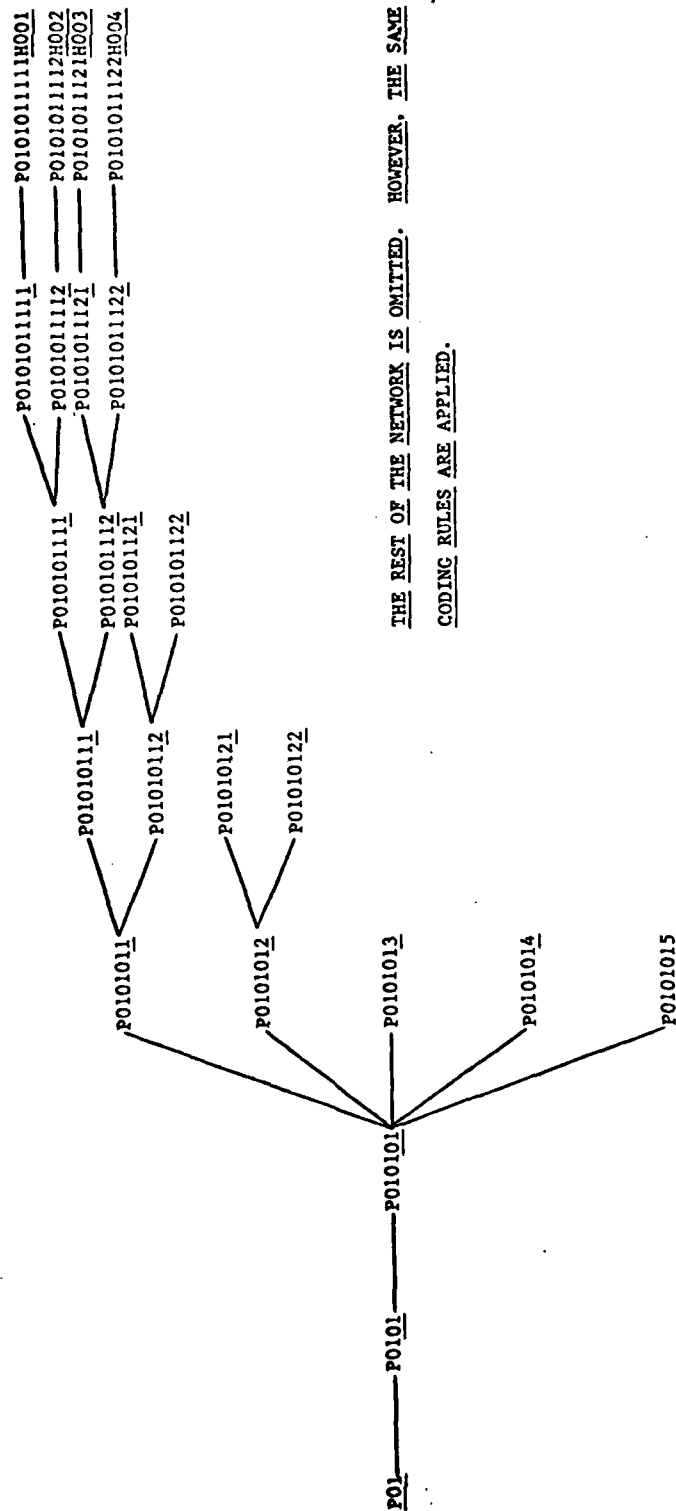
Figure 2 presents the skeleton of a hypothetical decision network in which the code numbers for various segments of the tree have been applied.

Figure 3 shows how a single code number disaggregates into its constituent parts.

SOME ADDITIONAL CODING REQUIREMENTS FOR THE FORECAST 90 COMPUTER PROGRAMS

The coding procedures described to this point present the basic coding structure for the FORECAST 90 networks. However, several additional coding conventions are required to make the networks operable on the computer programs written for FORECAST 90. These additional coding conventions are outlined as follows:

- End point for node numbers.
- Designation of node location ("level") in the network.
- Designation of the number of "children" of the node.
- The maximum number of spaces of text permitted for each line in a node.
- The introduction of an end of text for a specific node delimiter.
- Conventions on placement and spacing of the node entries.



THE REST OF THE NETWORK IS OMITTED. HOWEVER, THE SAME CODING RULES ARE APPLIED.

Trend	Determining Factor	Catalytic Events	Affected Activities	First-Order Effects	Second-Order Effects	Third-Order Effects	Decisional Outcomes
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Figure 2. An Example of the Network Coding System from Trend to Decisional Outcomes.

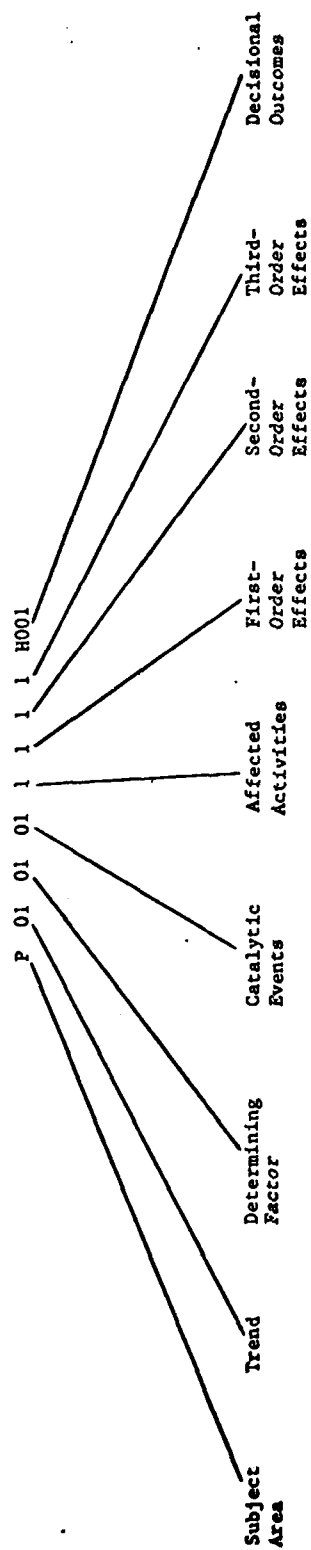


Figure 3: Components of the Code for a Network Node.

End Points for the Node Numbers

Because of certain technical requirements of the FORECAST 90 computer programs, all node numbers used to designate (1) the trend, (2) the determining factor, (3) the catalytic event, (4) the affected activities, (5) the first-order effects, (6) the second-order effects, and (7) the third-order effects must end with a period immediately after the code number assigned to the node. Node numbers for the decisional outcome nodes must have a period inserted between the number used to designate the third-order effect and the H that is the lead character for the decisional outcome column in the tree. The following examples show how these periods are to be inserted into the node numbers.

• Trend	P01.
• Determining Factor	P0101.
• Catalytic Event	P010101.
• Affected Activities	P0101011.
• First-Order Effects	P01010111.
• Second-Order Effects	P010101111.
• Third-Order Effects	P0101011111.
• Decisional Outcomes	P0101011111.H001

Designation of Node Location in the Network

Each FORECAST 90 network has a common structure that moves sequentially from the trend to the decisional outcome. Each step in this sequence constitutes a level--that is, a specific type of location--in the networks. Hence, to aid in the preparation of the network nodes for computerized processing with the NET1 program,¹ the level in the network in which the particular node occurs must be marked two spaces before

¹ NET1 is discussed in the "User's Manual for the FORECAST 90 Computer Programs."

the node number with a single digit entry. Entries for each node level in the network are given as follows:

- 1 Trend
- 2 Determining Factor
- 3 Catalytic Event
- 4 Affected Activities
- 5 First-order Effects
- 6 Second-order Effects
- 7 Third-order Effects

For example, if the node number is P010101. we know from the structure of the network code that this is a node number for the catalytic event included in the tree. Hence, the node level designation should be a "3" that is added two spaces before the node number. Thus, the number sequence becomes 3 P010101.

Designation of the Number of "Children" Branching from the Node

One additional bit of information required for network application on the computer is the number of branches (or "children") generated from each of the nodes in the first seven levels of the network (that is, from trend through third-order effects but excluding decisional outcomes). Again, a single digit is added to designate this information. The extra digit is added immediately after the node level designation and immediately before the node number. For example, each catalytic event (that is, level 3 of the tree) always has five "children" branching from it (U.S./USSR relations, U.S./PRC relations, U.S./Japanese relations, U.S./other country relations). Thus, to continue the earlier example, the node level number, the number of children designated, and the node number for a hypothetical catalytic event would be 35P010101.

Maximum Number of Spaces Per Line of Text in the Node

The computer programs that are used to store and print the completed networks are being developed to read lines of text that are up to 32 characters

long (that is, eight 4-digit computer words). Hence, no single line of text used in the nodes to describe the occurrences at that point in the network can exceed 32 characters and still be read by the computer. Where the line is longer than 32 characters, the computer program simply reads the first 32 characters and stops reading once the thirty-second character has been encountered. Particular diligence must be exercised to make sure that the text-line length does not exceed the maximum size that the program can accommodate.

Text End Delimiters

The text for each node in the tree must include a special character in a particular location to signal the computer that (1) all of the information for a specific node has been encountered so that (2) it can proceed to the next node in the tree. Two delimiters are recognized by the program. First, for nodes that end with a line of text and do not have a GO TO statement referring to another node in the same or another tree, the last line of text must begin with a slash (/). The occurrence of a slash in the space reserved for the node will signal the computer program that the last line of information has been encountered for the node that it is currently reading. The node presented below illustrates the placement of a slash (/) delimiter.

```
43P0105011.  
US/USSR RELATIONS. US AND USSR  
ARE THE OUTSIDE POWERS THAT ARE  
MILITARILY MOST INVOLVED IN THE  
/PERSIAN GULF.
```

Note that the delimiter is applied to the last line of the text. Also note that the delimiter must occur in a specific column--that is, the first column of the last line immediately before the text message. So long as a slash is not encountered in this column, the program will continue reading. Once the slash is encountered, the program moves on to the next node in the network.

The second delimiter that may be used is the asterisk (*). This delimiter should be used only with nodes that end with GO TO statements. It is a substitute for the slash delimiter and is not to be used in addition to the slash. It is always entered as the first character in the final line of text for the node. Consider the following example.

```
61P010501221.  
  PRC PROMISES MILITARY AID  
  TO IRAN.  
*GO TO P01050121.
```

This node refers the reader (or the computer) to another location in the network through the GO TO convention discussed in Chapter 2 on network construction. Since GO TO is a specific type of text that is later used in the computer output for the decision networks, it is given a special delimiter to signal that a GO TO statement has been encountered and must be stored. Given its specific purpose, the asterisk delimiter is never used other than with a GO TO statement. Under no condition should a GO TO statement ever have a slash as its delimiter.

- Each node must end with a delimiter.
- Only two delimiters are legitimate, a slash (/) or an asterisk (*).
- Only one delimiter is to be used for each node. The application of two delimiters in a single node will cause serious error problems that will cause the computer program to fail for that node.
- The slash (/) delimiter is to be used where the node ends in a line of text. The asterisk (*) delimiter is to be used only to designate a GO TO statement.
- A single node can have more than one GO TO statement. In fact, there is no limit to the number of GO TO statements that can occur in a single node. However, each GO TO statement must be preceded by an asterisk (*) delimiter.
- The delimiter must be placed in the first column of the last line. If it is out of place (as in the second column), it will be missed and serious problems will be generated for the computer program.

Character Placement and Spacing

For the computer program to operate on the nodes as they are coded by individual analysts, particular attention must be devoted to the placement and spacing of characters in the node. Even minor deviations from the prescribed coding rules can create major problems for the construction and operation of computerized decision networks.

The first line of the node must always consist of the node level, node children designation, and the node number. Lines of text that describe what has occurred in the node should appear next. The text lines must begin one character to the right of the node level designation. The last line of the text must begin with a delimiter that signals the end of the node. This delimiter should be placed in the same column as the node level designation (that is, one column before the text for the node).

Examples of four different kinds of nodes with all of the appropriate spacing can be illustrated as follows:

61P010501211. /USSR-PRC TENSIONS INCREASE.	(A single line of text)
61P010501212. USSR WARNS PRC TO REMAIN OUT OF /MIDDLE EASTERN AFFAIRS.	(Two lines of text and no GO TO statements)
61P010501532. ISRAELI FORCES ATTACK SYRIA. *GO TO P010401.	(A GO TO statement with its delimiter)
62P0105011111. TENSIONS BETWEEN US AND USSR RISE. *GO TO P010501211. *GO TO M0104023121. *GO TO M010203111.	(A node with multiple GO TO statements, each with its own delimiter.)

AN EXAMPLE OF NETWORK CODING APPLIED TO A FORECAST 90 NETWORK

In the chapter on network construction we presented the substantive example of the construction of a FORECAST 90 network that dealt with the impact

of a catalytic event in which Iran and Iraq went to war over the Kurdish problem. In this section, we repeat the nodes that were given there with the appropriate coding and spacing added for the nodes.

The first section of every network is the trend, the determining factor, the catalytic event and the affected activities. Once properly coded these sections of the Iranian-Iraqi war network would appear as they are presented in Figure 4. Note particularly that each node number fits the form outlined in this chapter of the manual and that all of the conventions on network coding and character spacing are met.

Figure 5 presents the network for the U.S./other country relations to illustrate how the codes are applied to that section of the network. Note particularly that the node level and children designations are correct and in the form necessary for the computer program to operate. Thus, with the designation of a node level "6" and the children number "2" (as occurs in the first entry in the second column on Figure 5), we should find two nodes beginning with "71" after the sixth level node.

Finally, note that each of the seventh level nodes has a "71" node level and children number designation and that each eighth level node has an "80" level and child designation. As noted in Chapter 2 on network construction, each third-order effect (that is, the seventh level of the tree) produces only one outcome. Hence, all are numbered with one branch coming from the seventh level. Similarly, the eighth level of the tree is the terminal point of the network. Thus, there are no branches designated for it.

SUMMARY

The structure of the network coding system has been presented and applied in this chapter. Discussion has also focused on the additional requirements of the code called for in the FORECAST 90 computer programs. Where possible, general rules to guide the application of the code have been formulated and explicitly stated.

43P0105011.
/US/USSR RELATIONS.

43P0105012.
/US/PRC RELATIONS.

42P0105013.
/US/JAPAN RELATIONS.

42P0105014.
/US/WEST EUROPE RELATIONS.

43P0105015.
U.S./OTHER COUNTRY RELATIONS.

6 11P01.
/DETENTE.

21P0105.
ABSENCE/PRESENCE OF SITUATIONS
PRESENTING SIGNIFICANT OPPORTU-
NITIES FOR MAJOR ACTORS TO IN-
/CREASE OR EXPAND INFLUENCE.

35P010501.
IRAN-IRAQ WAR. IRANIAN ARMED
FORCES CROSS OVER INTO IRAQI
KURDISTAN TO SAVE THE PERS MERGA
(KURDISH GUERRILLAS) FROM TOTAL
DEFEAT. IRAQ ACCUSES THE U.S.
IRAN AND ISRAEL OF HAVING INVAD-
ED IT AND ASKS USSR AND THE ARAB
LEAGUE COUNTRIES FOR MILITARY
/SUPPORT.

Figure 4: Coding a Sample Tree for Trends to Affected Activities.

US/OTHER COUNTRY RELATIONS.	52P01050152. SYRIA, SOUTHERN YEMEN AND LIBYA PROMISE MILITARY AID /TO IRAQ.	52P01050151. ARAB COUNTRIES DEMAND AN IMMEDIATE WITHDRAWAL OF IRANIAN FORCES FROM /IRAQ.	62P010501511. IRAN WANTS ALL COUNTRIES AGAINST GETTING INVOLVED /IN A LOCAL DISPUTE.	71P0105015111. SYRIA PROMISES MILITARY AID TO IRAQ. *GO TO P01050152.	80P0105015111.H SAME AS P0105015201.H007 /THROUGH P0105015321.H019
			61P010501512. IRAN WANTS ARAB COUNTRIES THAT IRANIAN FORCES WOULD TREAT ANY COUNTRY AIDING /IRAQ AS AN AGGRESSOR.	71P0105015112 SYRIAN FORCES ENTER IRAQ TO SUPPORT IRAQI FORCES. *GO TO P01050153.	80P0105015112.H SAME AS P0105015321.H020 /THROUGH P0105015321.H031
				71P0105015121. /NO THIRD ORDER EFFECT.	80P0105015121.H026 (-)DEFENSE DECREASES. THE ESCALATION OF CONFLICT INCREASES THE STRENGTH OF /CONFLICT AMONG MAJOR POWERS.
			62P010501521. ISRAELI MOBILIZES ITS ARMED FORCES TO PREVENT SYRIAN FORCES FROM JOINING IRAQ. *GO TO P010401.	71P0105015211. EGYPT MOBILIZES ITS FORCES AND WANTS ISRAEL AGAINST /ATTACKING SYRIA.	80P0105015211.H017 (-)DEFENSE IS DECREASED. THE ISRAELI MOBILIZATION /ENDANGERS DEFENSE
			61P010501522. IRAN WANTS SYRIA AND LIBYA THAT IRANIA ARMED FORCES COULD PURSUE ANY ATTACKER /TO WHEREVER THEY CAME FROM.	71P0105015212. SYRIA ACCUSES IRAN AND ISRAEL OF COLLUDING TO TAKE OVER ARAB OIL-FIELDS AND ASKS /FOR ARAB AID.	80P0105015222.H028 (-)DEFENSE IS DECREASED. THE ISRAELI MOBILIZATION ENDO- /GERS DEFENSE.
				71P0105015221. /NO THIRD ORDER EFFECT.	80P0105015221.H029 (-)DEFENSE IS DECREASED. THE ESCALATION OF CONFLICT /DECREASES DEFENSE.
			61P010501531. IRANIA FORCES CUT THE IRAQ- SYRIAN OIL PIPELINE IN RETTALIATION FOR THE SYRIAN /INTERVENTION.	71P0105015311. /NO THIRD ORDER EFFECT.	80P0105015311.H030 (-)DEFENSE IS DECREASED. IRAN'S ACTIONS INCREASE THE DANGER OF MAJOR POWER INVOLV- /MENT.
			61P010501532. ISRAELI FORCES ATTACK SYRIA. *GO TO P010401.	71P0105015321. /NO THIRD ORDER EFFECT.	80P0105015321.H031 (-)DEFENSE IS DECREASED. THE INVOLVEMENT OF USSR AND US /INVOLVEMENT BECOMES MORE HIGH

Figure 5: Coding a Sample Tree from First-Order Effect to Decisional Outcomes.

With the information that has been presented in Chapters 2 and 3, an analyst is in a position to write a new network, apply the codes that are required to designate each of the separate nodes of the tree, and enter the signal codes that are required to use the network storage and retrieval programs written for FORECAST 90. One additional aspect of network construction has not yet been presented. Hence, the next chapter deals with the means used to combine--or integrate--the 52 networks constructed thus far.

4. NETWORK INTEGRATION

One purpose of FORECAST 90 is to stimulate decision-makers and staff members to consider systematically the implications of alternative actions and policy positions across a broad range of areas. Thus, the military implications of political actions and events should be considered part of the formulation of responses to "political" problems. Similarly, the political implications of economic policies must be evaluated. The difficulty of relating seemingly unrelated parts of a diverse problem is particularly salient for users of the FORECAST 90 networks. Here, 52 separate and distinct networks have been constructed to project alternative outcomes for present global trends to the 1990 time frame. How these networks could be fitted together was a serious obstacle to the FORECAST 90 effort.

Given the project's focus on relationships that may be obtained across several different but interrelated areas, the development of a procedure that would permit the combination or "integration" of the networks written for FORECAST 90 was given considerable attention. The networks have been joined using the cross-over and combination procedures that are described in this chapter. Hence, each network is tied to at least one of the other networks. How this tie-in is developed and executed is described here.

In discussing network integration, the logic of the process is considered first. Each part of network integration -- equivalence identification and impact assessment -- is discussed in turn. The structure of the coding system used to isolate the cross-over points is discussed and some coding conventions developed in integrating the 52 FORECAST 90 networks are presented. An additional section of the chapter deals with some conventions that must be followed in preparing the equivalence codes for use in the FORECAST 90 computer programs. Finally, the chapter deals with a discussion of some different types of network cross-overs that were observed and the varying patterns of impact that they generated.

THE LOGIC OF NETWORK INTEGRATION

Network integration is a two-part task. First, a way must be found to locate common points in different networks that can be used to join either related or seemingly unrelated networks. Second, once the points at which the networks are to be joined have been isolated, the way(s) in which the two networks fit together must be assessed. Does the first network logically precede the second? Do they both occur simultaneously? Does the second network contain a series of events that are likely to produce one or more responses in the first network? These questions must be answered to determine how the networks are related to one another.

The first of these problems will be considered under the search for equivalence. The second problem is considered under attempts to assess the impact of one network on another. Each will be treated in turn.

Network Equivalence

The basic problem in defining network equivalence is depicted in Figures 1 and 2.¹ Two networks that have been written separately are depicted. These two networks may deal with the same specific catalytic event considered from different subject area perspectives (for example, the military implications of a spread of nuclear weapons in a new geographic region or the political implication of that same nuclear proliferation). Alternatively, the nets may deal with events that could be interrelated, but which could also occur separately (for example, a war in the Middle East and the imposition of an oil embargo from selected Persian Gulf states).

Each network may contain one or more nodes that are structurally similar to one or more nodes in the other network. Each may contain one or more nodes that are a plausible antecedent of one or more nodes that occur in another tree. Thus, a procedure is required to isolate nodes in

¹ The figures are adapted from Thompson (1974).

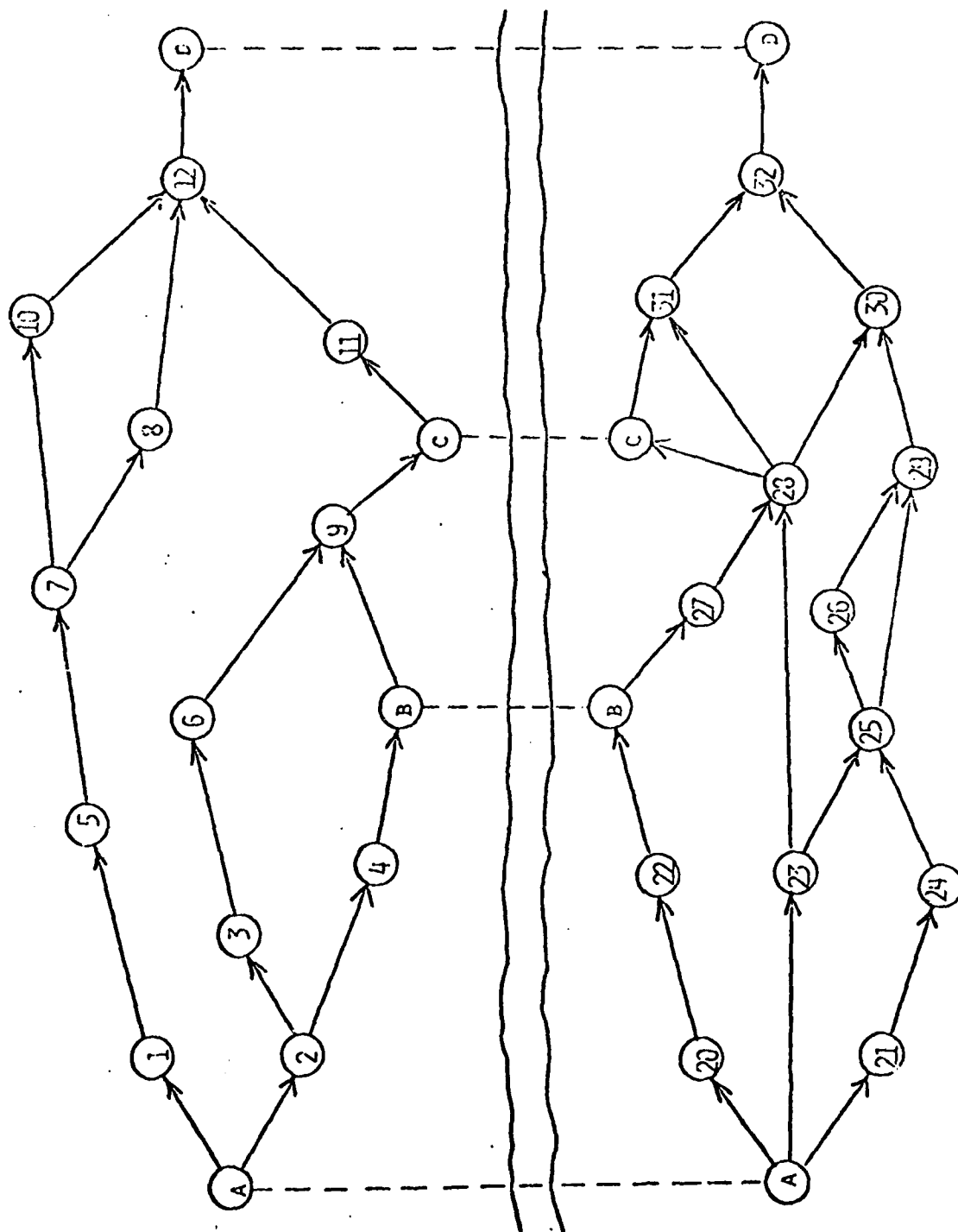


Figure 1. Two Distinct Networks with Potential Cross-over Points

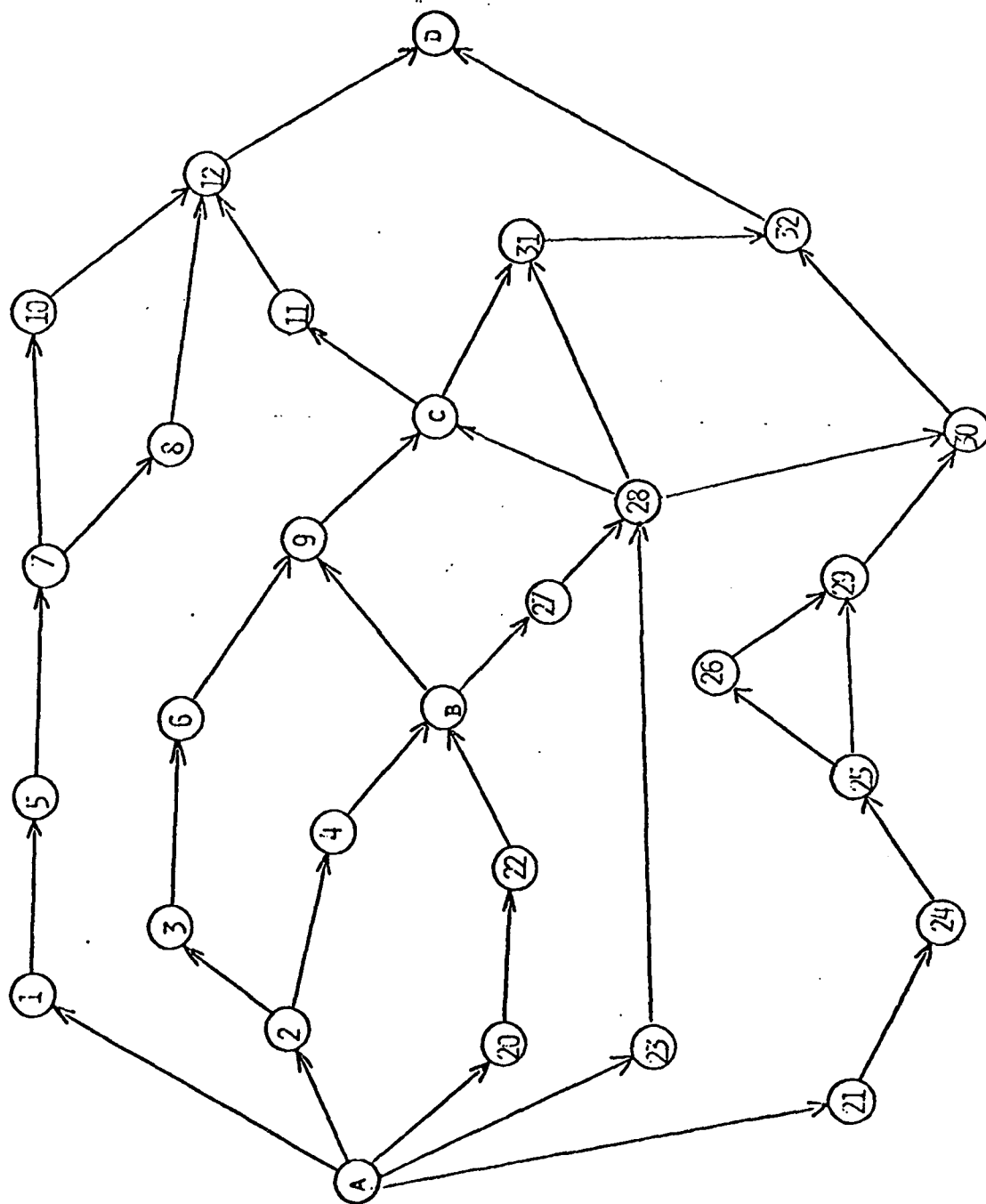


Figure 2. Two Integrated Networks

separate trees that can be considered structurally similar so that the effort at further identification of the ways in which the networks might be related to one another can be focused on these points. We term these points -- designated by letters in Figure 1 -- "cross-over" points. Here, each node is equivalently structured such that the occurrences in one of these nodes in one tree closely resemble occurrences in the counterpart node in another network.

Once identified, the object in network integration is to join these cross-over points to one another to obtain the result depicted in Figure 2. Hence, node A in the first network is joined with node A in the second network; node B is joined with node B in the second network; and so on until all commonly structured nodes have been combined with one another to create the integrated network shown in Figure 2.

The Impact of Cross-Overs from One Network to Another

Identification of the network cross-overs is only the first task in network integration. After the equivalent nodes have been identified, careful attention must be devoted to determine how the networks are associated with one another. The networks can be considered only after the impact of one network on another has been assessed.

There are two general classes of network impact that should be consistently looked for. They are:

- One-way impact in which one network has subsequent (down-stream) implications in a second network,
- Two-way (joint) impact in which each of two networks produces down-stream effects in the other network.

In one-way impact, one network crosses over to a second network and influences subsequent occurrences in that second network. For example, assume that an occurrence in the fifth level (that is, the first-order effect) of a political network is structurally similar to a node in the

fifth level of a military network. For one-way impact to occur in these networks, the activities in the fifth level political node must have some impact on the later effects (that is, sixth and seventh levels) in the military tree. If this condition is obtained, the political network can be said to have a one-way impact on the military network as the political activities are thought to influence, or to lead to, the occurrence in the sixth and seventh levels of the military network rather than vice versa.

Contrasted with one-way impact is two-way impact, in which there is no clear delineation about which of the two networks precedes the other. For example, the events in a political network could influence the later actions in a military network and the events in a military network could also influence the later occurrences in the political network. In short, each influences the structure of the other to create a joint -- or two-way -- impact.

In general terms, this combination of considerations -- the identification of network cross-over points and the assessment of the impact of one network on another -- will together yield an integrated set of networks in which occurrences in one network can be said to cross-over to and impact on other networks in the FORECAST 90 system. While the logic of the procedure and the tasks involved are generally straightforward, the actual operational procedures used to isolate the equivalent nodes and assess the kinds of impact isolated are not. Therefore, the next two sections of this chapter discuss the operational procedures that must be followed to identify network cross-over points and to assess the impact of potential cross-over points identified through this process.

IDENTIFYING CROSS-OVER POINTS

The key notion in the integration of the networks is a definition of an equivalent node that can be used to cross from one network to another. If the notion of equivalence that has been used in previous FORECAST 90 work is followed (Thompson, 1974), equivalent nodes are those in which

similar participants engage in similar activities over a similar subject. In other words, the participants in the activities reported in the node, the actions taken, the sequence in which these actions occur, and the substantive and geographical context in which they occur are critical to the definition of equivalence.

This basic orientation was used to formulate a coding scheme that is general enough to capture the participants, the actions taken, and the context in which the activity takes place in any of the FORECAST 90 networks. Hence, each first-, second-, and third-order effect (that is, the places in the networks where occurrences specific to each one of the nets that might have implications for the occurrences in other networks may be found) was coded for five types of information:

1. Actors (countries or groups of countries) who initiate the exchange reported in the node
2. Actions taken by the actors
3. Target or targets toward whom the action is directed
4. Geographic location in which the action occurs
5. The substantive topic over which the exchange has occurred

Thus, a multiple-digit equivalence coding sequence for each first-, second-, and third-order effect in each of the 52 networks written in for FORECAST 90 is produced. The details of the codes used to construct these equivalence identifications and the rules for coding these equivalence sequences are discussed next.

The Structure of the Coding System

Each node expresses either actions taken by one country or set of countries toward another or other countries or decisions by similar actors or sets of actors not to act. Additionally, the nature of the action taken at these times in the networks is clear and codeable as is the

context in which the action is taken. Thus, a coding sequence has been developed to capture (1) the country or countries that initiated the action at the particular node, (2) the target or targets toward which the actor is deploying the action, (3) the action or actions taken, and (4) the nature of the substantive topic and the geographic location in which the action is undertaken.

To illustrate the structure of the nodes, consider the following example.

PO1010111.
THE US AND ISRAEL CHARGE THE
USSR AND PRC WITH AIDING ARAB
/TERRORISTS.

Brief as it is, this node message has a clear structure. Two actors (the United States and Israel) have engaged in an activity (charging illegal aid) directed toward two targets (the Soviet Union and the People's Republic of China) on a specific substantive topic (the Arab-Israeli dispute) and in specific geographic locations (Washington and Tel Aviv). This structure can be translated into a 19-digit sequence in which information is coded on the first actor, the second actor, the action taken, the first target toward whom the action is directed, the second target toward whom the action is directed, the geographical region in which the action occurs, and the substantive topic around which the exchange has occurred. Once coded in this manner, equivalence is defined as an identical sequence of actors, actions, targets, locations, and substantive topic. Since the sequence of the actions and the context in which they are undertaken are critical to the definition of equivalence, true equivalence does not exist if any element is absent. In short, while there may be considerable similarity in the structure of the actions between two nodes, the sine qua non for equivalence is the presence and order of all elements in the sequence.

The 19-digit sequence that is coded for the identification of an equivalent structure is as follows:

- First actor identified (columns 1-3 of the code)
- Second actor identified (columns 4-6 of the code)
- Action taken/signaled (columns 7-9 of the code)
- First target identified (columns 10-12 of the code)
- Second target identified (columns 13-15 of the code)
- Geographic region in which the action occurs (column 16 of the code)
- Substantive topic of the interaction (columns 17-19 of the code)

Construction of the Codes

Each part of the code used to capture structural equivalence in the nodes will be discussed separately. The codes have been developed with categories that are designed to handle the requirements of cross-over identification in the 52 nets already prepared for FORECAST 90 and yet be general enough to apply to additional networks as they are developed. In each case, an existing coding system of some type was tested and modified to fit better the requirements imposed by the FORECAST 90 networks.

Actor/Target Codes. Based on the frequencies of occurrence in the existing 52 networks, two actors and two targets have been coded for each of the first-, second-, and third-order effects. These codes were taken from an existing, standardized list of countries and intergovernmental organizations (Russett, et al., 1968). Additional entries were added to those obtained from the Russett, et al. list as they were encountered in the FORECAST 90 networks.

Table 1 presents the first page of the actor and target codes. Although listed alphabetically for ease of reference, there is a structure to the codes.

TABLE 1
 Alphabetical Listing of Countries as Actors/Targets

<u>Number</u>	<u>Country or Group</u>
700	Afghanistan
161	Africa
405	African LDC's
339	Albania
615	Algeria
998	All Countries Other Than Superpowers
232	Andorra
589	Arab States
160	Argentina
161	Argentina & Peru
173	Arms-Exporting Nations
704	Asia
702	South Asia
704	Southeast Asia
899	ASEAN (Association of Southeast Asian Nations)
898	Asian LDC's (Asian People's Development Program)
900	Australia
305	Austria
400	Azores
771	Bangladesh
053	Barbados
211	Belgium
145	Bolivia
146	Bolivia and Peru
140	Brazil
141	Brazil and Chile
355	Bulgaria
775	Burma
516	Burundi

Generally, entries numbered below 200 are located in the Americas. Those with numbers 200-400 are located in Europe, while those in the 400's are in Africa. The 500's and 600's contain primarily North African and Middle Eastern states (although there are some Sub-Saharan African states in this set). The 700-900 numbers are for various Asian states, while those with numbers over 900 are in Oceania. The actor/target codes are fully listed in Appendix II.

With two exceptions, only independent countries, intergovernmental organizations and groups of countries were coded as actors or targets. The first exception was for territories of countries in which the United States had important bases, such as the Azores and Okinawa. Here, the territory itself was assigned a separate number. The second exception was for a finite number of politically important sub-national groups whose actions could be of interest or concern to U.S. national security policy. Included in this category were terrorist groups such as the Palestine Liberation Organization and various people's revolutionary governments. Again, each of these was assigned a separate code number.

Action Codes. The action codes summarize the specific activity that is mentioned in each node. As an inspection of Table 2 (where a selection of these codes is presented) will show, these action codes are hierarchically structured as specific action words have been grouped into more general action categories. Thus, a general category (01 Accomplish) is further broken down into 10 additional and more specific references to the same kind of activity (010 Achieve to 019 Conclude). Each action code meets this structure. Appendix III lists all of the action codes.

The action codes were modeled after the World Event/Interaction Survey (WEIS) codes (McClelland and Hoggard, 1969; CACI, 1973, 1974a, 1975a). Since the existing WEIS codes did not adequately describe the contents of the 52 FORECAST 90 trees, new action codes were constructed by quickly reading through a number of the networks to develop a list of specific action words. These words were then grouped into more general action

TABLE 2
Action Type Codes

<u>General Category</u>	<u>Specific Breakdown</u>
01 Accomplish	010 Achieve 011 Succeed 012 Solve 013 Resolve 014 Decide 015 Satisfy 016 Dominate 017 Control 018 Stabilize 019 Conclude
02 Accuse	020 Accuse 021 Denounce 022 Criticize/Decry 023 Warn 024 Threaten 025 Condemn 026 Resent
03 Acquire	030 Acquire 031 Produce 032 Buy/Produce 033 Take 034 (word omitted) 035 Receive 036 Invest 037 Overbid 038 Outbid
04 Aggravate Relationships	040 Aggravate 041 Expel 042 Revoke 043 Seize 044 Confine 045 Restrict 046 Purge 047 Irritate 048 Subvert
05 Agree	050 Agree 051 Accept 052 Accede 053 Allow 054 Permit 055 Encourage 056 Cooperate 057 Concur 058 Welcome

categories, and the product was used to code a set of the FORECAST 90 nets. After some additional revision to incorporate words that were encountered at this point, the codes presented in Table 2 were used to code all of the 52 FORECAST 90 trees for action type.

As a general rule, where the exact word found in the node was not on the list of action words, coders were instructed to use the closest synonym that was on the code list. Once this strategy was employed, the coders experienced no difficulties in placing entries in the equivalence sequence.

Geographical Regions Code. In an effort to use the most generally accepted grouping of countries into geographical regions, the groupings of countries made for JCS planning were employed. One addition was made to the JCS list to meet a problem encountered in the FORECAST 90 networks. A new joint region (with a code "0") was created to handle the rather common occurrence in which an action took place in more than one region at the same time. For example, where the United States and the Soviet Union agreed jointly to do something, the action was undertaken in both Washington (JCS region code = 1) and Moscow (JCS region code = 4). Hence, to take this joint activity into account, a new code for multiple regions (code = 0) was created. Table 3 gives the JCS regions and the codes employed in coding the geographic location of the occurrence of the action.

TABLE 3
JCS World Regions

- 1 North America
- 2 Central and South America
- 3 Western Europe, the Mediterranean, and the Atlantic
- 4 Eastern Europe and the USSR
- 5 Middle East and North Africa
- 6 South Asia, Indian Ocean, and Sub-Saharan Africa
- 7 Pacific Area and East Asia
- 8 Polar Regions (Arctic and Antarctic)
- 9 Space
- 0 Other, Multiple Regions, the World

Substantive Topic Codes. The substantive topic codes represent an attempt to capture the basic subject area over which the action(s) described in the node has (have) occurred. Whereas the action codes deal with the specific action taken or threatened in the node, the substantive topic codes deal more generally with the topic about which the action was taken.

Table 4 presents a sample of the substantive topic codes, which, like the action codes, are hierarchically structured. Thus, the general category of exchanges over domestic economics (general category 02) was further represented by specific manifestations ranging from inflation (020) to economic development (028). These codes were developed after an examination of the existing 52 networks. Several additional categories were added to cover topics with which future FORECAST 90 networks might deal. Appendix VI lists all of the substantive topic codes.

SOME CODING CONVENTIONS AND EXAMPLES

Several coding conventions were developed by CACI in creating and applying the equivalence code. In this section these coding conventions will be presented, together with examples to illustrate the points.

Coding Multiple Actors and Targets

The equivalence code is structured to handle two actors and two targets for each interaction coded within a single code. However, it is frequently the case that variations from the expected number of actors and targets will be observed. Four such variations have been encountered frequently in this area.

First, there is only one actor and/or only one target in a number of the nodes. Where this is the case, the three-digit space in the equivalence stream should be filled with three zeros (000) and the rest of the coding should proceed as already discussed. The following node illustrates the occurrence of a single actor and a single target.

TABLE 4
Substantive Codes

<u>General Category</u>	<u>Specific Breakdown</u>
01 Agriculture	010 Crop Production/Failure 011 Plant and Animal Diseases 012 Food Supply/Price 013 Fertilizers 014 Irrigation
02 Domestic Economics	020 Inflation 021 Unemployment 022 Labor 023 Productivity 024 Investment 025 Credit 026 Recession/Depression 027 Strategic Industry 028 Economic Development
03 Domestic Instability	030 Political Unrest 031 Communist Take-over 032 Civil War 033 Racial Disturbances 034 Insurrections 035 Secessionist Movement 036 Guerrilla Warfare (unaided by outside groups) 037 Coups d'etat 038 Purges
04 Domestic Political Processes	040 Changes of Government 041 Elections 042 Leadership Changes 043 Ideologies
05 Energy	050 Conservation/Use 051 Availability/Access 052 Resource Development 053 Fossil Resources 054 Geothermal/Solar 055 Nuclear Power 056 Economic Dependence 057 Water Resources 058 Production
06 Environment	060 Pollution 061 Weather Modification 062 Water Treatment 063 The Oceans 064 The Atmosphere 065 Natural Disasters

EO10101123.
MEMBERS OF THE EEC AGREE TO
TARIFF NEGOTIATIONS WITH THE
/UNITED STATES.

The equivalence code for this node, gathered from Tables 1-4, is
3970000500020003136. This sequence is broken down as follows:

- first actor (EEC = 397)
- second actor (no second actor = 000)
- action (agree = 050)
- first target (US = 002)
- second target (no second target = 000)
- geographic region of action occurrence (Western Europe,
Atlantic and Mediterranean = 3)
- substantive topic (international negotiation/economic
negotiations = 136)

Note that a code of 000 has been inserted for the second actor and the second target in each case. Under no condition should the physical space set aside in the equivalence code for a second actor or target be deleted if there is only one actor or one target. Always fill the spaces in the code, even if only with zeros.

Determining which country is to be considered the first actor (or target) and which is to be considered the second actor (or target) is a second problem that can arise in coding actors and targets. Generally, one can tell from reading the node which of the countries is the more important in the interaction, and thus the one to be termed first actor or target. No matter how insignificant its role, if the United States is mentioned in a node as either an actor or a target, it must be coded as the first actor or the first target. Similarly, if the United States is not mentioned in the node and the Soviet Union is mentioned in the node, no matter how insignificant its role, the Soviet Union is to be

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considered the first actor or target. Where both the United States and the Soviet Union are mentioned as actors (or targets) in a single node, the United States is to be considered the first actor (or target) and the Soviet Union is to be considered the second actor (or target). The following node illustrates these conventions.

P010801222.

THE US AND USSR REQUEST THE UN
TO CONSIDER THE PROBLEM OF
/WORLD FAMINE.

The equivalence sequence for this node is 0023652023990000082, which breaks down as follows:

- first actor (US = 002)
- second actor (USSR = 365)
- action (request = 202)
- first target (UN = 399)
- second target (no second target = 000)
- geographic region (combined regions = 0)
- substantive topic (health and welfare/famine = 082)

Note that the United States has been listed first despite the fact that there is no information given in the node that the United States was actually the first actor.

A similar ordering of countries is to be used when other major powers are included in a single node. The ordering that has been used in coding the 52 FORECAST 90 networks is listed as follows:

- United States
- Soviet Union
- People's Republic of China

- Major Western European countries/NATO
- Japan
- Other countries ordered by an analyst's judgment of their importance.

Where any one of the states occurring higher on the list is included with a country in a node, the country with the highest list position is to be placed first and the next highest is to be placed second.

A third convention on the coding of actors and targets arises when there are more than two actors and two targets. Here, the most important of the countries is entered as the first actor. The remaining countries (two or more) are then grouped together and given a unique number in the actor/target code. Many combinations of countries have been encountered in the first 52 networks. Hence, the list given in Table 1 should be checked carefully before any additional combinations are assigned code numbers.

For example, consider the following node.

P010201113.
THE US, VENEZUELA AND PERU
PROTEST THE CHILEAN NAVY'S
SHOW OF FORCE OFF OF PERU'S
/COAST.

This node would be equivalence-coded as follows:

- first actor (US = 002)
- second actor (Venezuela and Peru = 103)
- action (protest = 210)
- first target (Chile = 155)
- second target (no second target = 000)

- geographic region (multiple regions = 0)
- substantive area (international conflict/show of force = 113).

Thus, the equivalence code for this node is 0021032101550000113.

A fourth convention on the coding of actors and targets occurs when there is not enough information in the node to determine which country is an actor and which is the target. Thus, in nodes where some joint action by two or more countries is directed toward the other member(s) of the set, each country should be coded separately as an actor and as a target in two distinct codings. An example may clarify this point.

MO1050211.
THE US AND USSR AGREE TO
/RECONVENE THE MBFR TALKS.

It is clear in this node that the United States and the Soviet Union are involved. However, it is not clear which country initiated the action. Should the analyst be unable to determine which country initiated the action, either from the information in the prior node(s) or from this node, then two separate codings should be undertaken. In the first, the United States is coded the actor and the Soviet Union is coded the target. In the second, the places are reversed and the Soviet Union becomes the actor and the United States becomes the target. Thus, in the first instance, the equivalence code is 0020000503650000132 (the United States as the first actor, no second actor, an agreement action, the Soviet Union as a first target, no second target, the action occurring in multiple regions, and conventional arms negotiations as the substantive topic of the exchange). In the second coding, the Soviet Union becomes the actor and the United States becomes the target. Hence, the equivalence sequence is 3650000500020000132.

Coding Multiple Actions

Each first-, second-, and third-order effect, except for those in which there is a statement that there is "no effect" for the node (a situation discussed in Chapter 2), is to be coded for equivalence. There is no limit on the number of equivalent actions that can be coded for a single node. If there are three actions in a particular node, each should be coded so that the occurrences in the node can be accurately and completely described.

The following political node gives an example of a node with multiple actions in it, each of which is to be coded for equivalence.

P010602114.
ISRAEL ATTACKS SYRIA. THE
US AND USSR CALL FOR THE UN
TO IMPOSE A PEACE-KEEPING
FORCE ON THE GOLAN. OAPEC
STATES EMBARGO OIL TO THE
/US, JAPAN AND THE EEC.

This node contains three separate and distinct actions, each of which must be coded if the contents of the node are to be portrayed accurately. First, the action in which Israel attacks Syria must be coded. Second, the call by the United States and the Soviet Union for action by the United Nations must be coded. Finally, the imposition of an oil embargo by the Organization of Arab Petroleum-Exporting States (OAPEC) on the industrial world must be coded. Thus, three separate and distinct equivalence codes would be generated for this node. Each is to be coded following the conventions outlined to this point and each is to use the information contained in Tables 1-4 as the basis for the coding.

CODING EQUIVALENCE FOR COMPUTER UTILIZATION

With a mastery of the fundamentals of the structure of the equivalence code, the analyst is ready to code a newly constructed network for use in the computer search program that compares the equivalence codes from

different nodes to find those that are identical. As the "User's Manual for the FORECAST 90 Computer Programs" indicates in more detail, two programs -- NET2 and NET3 -- are available to search for equivalently structured nodes in different networks. Each of these programs operates from a particular data format and from information stored in a node information file (NIF). In this section guidance will be given on how data should be constructed to create this data file.

The equivalence codes generated for each first-, second-, and third-order effect node in each of the networks must be placed on FORTRAN coding forms for keypunching so that they can be entered into the node identification file. Each equivalence sequence is placed on a single line of the form as shown in Table 5. The node number is entered first, in the left-hand column of the form, and may take up to 11 spaces starting with column 1. Where the node number is less than 11 spaces long it should be right-adjusted. In other words, all node numbers should end in column 11 regardless of what column they have started in. Each node number should be coded without spaces in a single stream of a single letter and multiple digits.

Immediately across from the appropriate node number, starting in column 13 of the form, begins the 19-digit equivalence code for that node. Each equivalence code is placed on a separate line across from the node number of the node that it is describing. Where multiple actions are coded for a single node, the appropriate node number must be placed across from each entry. Each coding must begin on a different line of the FORTRAN form. Table 5 illustrates these points.

Over 5,000 computer cards were punched to capture the equivalence coding done for the first 52 trees constructed for FORECAST 90. These cards are stored in the existing node information file at the USAWC computer facility. As additional networks are written, they will have to be coded for equivalence and the cards thus produced will have to be added to the node information file. Once all nodes have been coded, punched up from this form, and entered into the node information file, the user

TABLE 5
Sample Equivalence Coding Form

M010303
 FORTRAN Coding Form

[illegible]

can refer to the "User's Guide for the FORECAST 90 Computer Programs" to learn how to run the NET2 and/or NET3 programs. After running either of these programs, output such as that displayed in Table 6 will be obtained. Here, each node that has been coded for equivalence is compared against either a prespecified sequence of equivalence codes (for NET3) or against all other nodes in the file (for NET2).

At the present time, the program is written to compare only the first actor, the general action category, the first target, the geographic region, and the general substantive code. In other words, although coded on the card for later use when the number of FORECAST 90 networks becomes appreciably larger, the second actor and the second target are not presently used in the equivalence search. Nor are the specific manifestations of the actions and of the substantive topic used in the present equivalence search. Rather, only the general categories are read. For example, if an action code of 021 (denounce) has been coded for a particular equivalence sequence, only the first two digits (for the general category 02 - accuse) are read. As the number of networks increases and more precision is required to find the equivalent nodes for network cross-overs, additional searches can be conducted for the more detailed codings. At the present time, however, only the more general information is utilized in the search for equivalence.

Table 6 presents the format in which the computer output groups the equivalent nodes. The node that has been used for the comparison is presented on the left. The nodes that are equivalent to it are presented in the middle column. The final set of columns presents the actual equivalent codes for the nodes that have been coded as equivalently structured. The first three columns are for the actor, the next two for the action, the next three for the target, the single one for the geographic region and the last two for the substantive topic. Where the middle column contains only the words "Equivalent Nodes" and no node numbers below it (as is the case for node P010303321), there are no nodes in any of the 52 networks with the same codings for actor, action, target, geographic region, and substantive topic.

TABLE 6
Sample Output From Equivalence Program

NODE	P010303244	EQUIVALENT NODES	205710	0	15
		P010303242	205710	0	15
NODE	P010303321	EQUIVALENT NODES	202740	0	12
NODE	P010303321	EQUIVALENT NODES	217740	0	12
		P0101023311	217740	0	12
		P010303322	217740	0	12
NODE	P010303322	EQUIVALENT NODES	217740	0	12
		P0101023311	217740	0	12
		P010303321	217740	0	12
NODE	P010303411	EQUIVALENT NODES	205397	0	10
		P010101431	205397	0	10
		P010101432	205397	0	10
		P0101014412	205397	0	10
		P0101014421	205397	0	10
		P0101014422	205397	0	10
		P0101014431	205397	0	10
		E010102411	205397	0	10
		P010102432	205397	0	10
		S0105025111	205397	0	10
NODE	P010303412	EQUIVALENT NODES	211397	0	10
		S0106014311	211397	0	10
NODE	P010303412	EQUIVALENT NODES	220995	0	10
		P0101021314	220995	0	10
		P0103021122	220995	0	10
NODE	P010303413	EQUIVALENT NODES	224397	0	10
		P0101014411	224397	0	10
		P0101014423	224397	0	10
		P0101014432	224397	0	10
NODE	P010303413	EQUIVALENT NODES	208397	0	10
NODE	P010303531	EQUIVALENT NODES	99724002	0	10
		P0101015331	99724002	0	10
NODE	P010303531	EQUIVALENT NODES	71022997	0	15
NODE	P010303532	EQUIVALENT NODES	39910995	0	15
		P0103031331	39910995	0	15
NODE	P010303532	EQUIVALENT NODES	39906995	0	15
NODE	P010303532	EQUIVALENT NODES	39914995	0	15
NODE	P0103031112	EQUIVALENT NODES	36508002	0	10
		P0103031132	36508002	0	10
NODE	P0103031121	EQUIVALENT NODES	36524399	0	10
		S0106011211	36524399	0	10
NODE	P0103031121	EQUIVALENT NODES	36502002	0	10
		P0108011231	36502002	0	10
		T010601121	36502002	0	10
		T010601122	36502002	0	10
		T010601123	36502002	0	10
		P010301124	36502002	0	10
		P010301134	36502002	0	10
		P01080112	36502002	0	10
		P01030311	36502002	0	10
		P01030313	36502002	0	10
		P0103025122	36502002	0	10
		P0103025231	36502002	0	10
		S0105021211	36502002	0	10
		S0105021312	36502002	0	10

Coding Aids

Two coding aids, developed by CACI for use in coding the first 52 FORECAST 90 networks for equivalence, are presented in Appendices IV and VII. In Appendix IV, the contents of Table 2 (the action codes) are alphabetized for easy reference. Thus, the person looking for a specific action word can seek it alphabetically rather than having to search through all of Table 2 for the word. The contents of Table 4 (the substantive codes) have been alphabetized in Appendix VII to aid in locating the appropriate substantive topic to depict what has occurred in a particular node.

ASSESSING IMPACT IN NETWORK INTEGRATION

After the equivalent nodes have been isolated based on the coding procedures discussed thus far, and the NET2 or NET3 program has been used to search through the node information file to identify the nodes with the same structure that occur in other networks, the next step in network integration is to evaluate the two nodes that have been coded equivalently to see whether they are, in fact, structurally equivalent.

This second step in the integration of the networks is necessary for at least two different reasons. First, the coding system developed to identify the structurally equivalent nodes contains very general categories. For example, there is no direct provision for coding occurrences (something did occur) distinctively from non-occurrences (something did not occur). Hence, the equivalently coded nodes might be quite different, and thus must be examined on an individual basis.

Second, even equivalently coded nodes may be the result of quite different developmental sequences that make them unlikely cross-over points. Thus, occurrences in one type of activity (for example, conventional arms expansions) may be coded the same way as occurrences in another type of activity (for example, strategic arms expansions). Hence, the

nodes that are identified as equivalent must be evaluated to determine whether they are both similar in structure and in substance so that they can be considered cross-over points.

Types of Cross-Overs Encountered

Five patterns of cross-overs that produced different types of impacts were encountered in integrating the 52 FORECAST 90 networks. These five types are general enough to provide guidance for the problems that might be encountered as additional networks are written and integrated into the FORECAST 90 system.

One-Way Cross-Overs. In one-way cross-overs, actions in one network directly and substantively affect actions in a second network. In other words, actions in the first network can be said to be part of the sequence of actions that could have plausibly generated the action in the second network. In the example that follows, an occurrence in an economic network on attempts by the European Economic Community to become economically, militarily, and politically autonomous crosses over to an occurrence in a socio-psychological network involving a relaxation of restrictions on population movement by the Soviet Union.

EO10103332.
US SUPPORTS USSR/JAPANESE TRADE
PACT AS STRENGTHENING WORLD
ECONOMIC COOPERATION. US STATES
DESIRE FOR OPEN ECONOMIC RELA-
TIONS WITH BOTH PARTIES.
*GO TO S0104013123.

S0104013123.
LEVEL OF JAPANESE PRODUCTION
INCREASES TO MEET DEMANDS OF
BOTH US AND SOVIET MARKETS.
US/JAPANESE COMMUNICATION AND
/TRADE ARE UNCHANGED.

Where a cross-over is found that is both structurally similar and plausible as a product of the sequence that has preceded it, the point

to which the cross-over is headed is designated by a *GO TO statement. Thus, at the end of the node from the economic tree, there is a *GO TO statement and the number of the node in the socio-psychological network to which the economic network is to cross. When a cross-over point has been isolated, the point to which the cross-over is to go is marked by a *GO TO statement. The use of the *GO TO statement in network integration follows the same rules that were defined in Chapter 3 on network coding.

Joint (Two-Way) Cross-Overs. Where a cross-over point has been identified and verified for substantive appropriateness, the usual procedure is to identify the direction that the crossing from one net to another should take. At times, however, the analyst is unable to determine which of the nodes is sequentially prior to the other. Hence, the direction of the cross-over is unclear. In these cases, a joint or two-way cross-over should be employed. A joint cross-over signals that an occurrence in the first network leads to an occurrence in the second network and the occurrence in the second network also influences the occurrence in the first network.

The following two nodes present an illustration of joint cross-overs. Note that each contains a *GO TO statement.

E0103024112.
US ARGUES W. EUROPE ECONOMIES
IN BETTER SHAPE THAN US; EUR-
OPEANS HAVE INTEREST IN US
RECOVERY. EUROPEANS REACT TO
REDUCE ECONOMIC TIES TO US.
*GO TO E010102412.

E010104412.
EEC ATTEMPTS TO SEPARATE ITSELF
FROM US; STATES ITS IMPOSITION OF
EMBARGO JUST A PROTECTIVE MEA-
SURE DUE TO US POLICY.
*GO TO E0103024112.

In this example, an economic network on a severe economic recession in the United States contains a node that crosses over to an economic network on a shortfall in North American grain and soybean harvests. In the first node, the United States argues its drastic steps in economic policy should be endured by the Europeans since they have a stake in America's economic well-being. The second node suggests that the EEC is attempting to separate itself from the United States in response to a ban on the exportation of grains to Western Europe due to the grain shortfall.

Since the analyst is unable to determine which node would have occurred first, each was made to cross to the other. Thus, the effects of U.S. economic policy decisions that harm Western Europe result in attempts by the Europeans to respond to a U.S. embargo and separate from the United States. Similarly, attempts by the United States to respond to a U.S. embargo result in a statement that U.S. policy actions are necessary for the revitalization of America's economic position, a position in which the Western Europeans have some stake. The formal vehicle for this joint (or two-way) cross-over is the use of a *GO TO statement for the nodes, referring each to the other node.

Third-Order Spreads. Perhaps the most commonly encountered cross-over pattern occurs from a third-order effect in one network to a third-order effect in another. Here, an occurrence in one network dealing with one trend has implications for a third-order effect and decisional outcome in a second network that often deals with an entirely different trend. For example, the third-order effect in a network on detente might cross-over to an economic network on economic interdependence as detente influences trade patterns. In other words, the non-political effects of a change in detente are suggested. Since this cross-over often occurs at the third-order effect level of the networks, it is referred to as a third-order spread in which the implications of an event are broadened by cross-overs to other trends.

The following two socio-psychological and political network nodes may help illustrate these points.

S0104013121.
JAPAN BECOMES LESS RELIANT ON
THE US AS A FOOD SOURCE. US-
JAPANESE SOCIAL COMMUNICATION
DECREASES AS TRADE FALLS OFF.
*GO TO P0108023321.

P0108023321.
US-JAPANESE RELATIONS
/DETERIORATE.

Each of these nodes is a third-order effect in a separate network (as an inspection of the node number for each will demonstrate). The cross-over to another network results in the sequence in the socio-psychological network having an impact on the socio-psychological trend (sense of world community) and the political trend (detente). Hence, the results are spread over different trends when the cross-over occurs at the third-order effect. Figure 3 graphically illustrates this point.

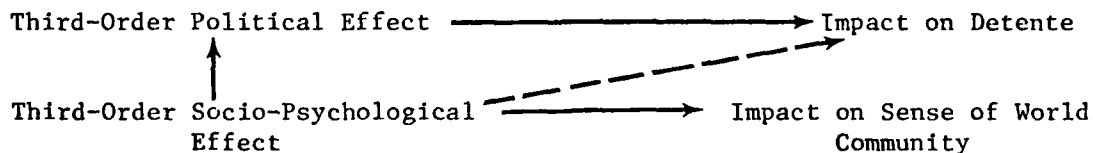


Figure 3. An Example of Third-Order Spreads

Network Sequencing. In several instances in the present FORECAST 90 networks, cross-overs were identified in which occurrences in one network led to events that have been the subject of a whole separate network. In other words, these particular networks could be placed sequentially behind one another (in boxcar-like fashion). Then, the activities in one node feed into an entirely different network, where the catalytic event is based on an occurrence in the first.

An example of this type of cross-over occurred in the political network on an Iranian-Iraqi war over the Kurds. After Iranian troops cross into Iraqi territory to aid the Kurds, other Arab states mobilize to assist Iraq. Israel, concerned that elimination of the Kurds will free Iraq for adventurism in the area, warns Syria not to aid Iraq. When Syria mobilizes to aid the Iraqi forces, Israel attacks to stop Syrian help from being used against the Kurds. Thus, the following node was written:

P010501532.
ISRAELI FORCES ATTACK SYRIA.
*GO TO P010401.

Network P010401 is an entirely separate treatment of events in the Middle East, starting with a preemptive strike by the Israelis against Syria. Each of these two networks was written separately, yet the first contains a node that leads to the second network. Hence, the two networks have been sequenced with an occurrence in one leading to an entirely different network.

P010401.
WAR IN THE MIDDLE EAST.
/ISRAEL ATTACKS SYRIA.

Network Elaboration. In some cases it may be necessary to create some additional down-stream nodes in one network as a result of a cross-over from another network. If one tree crosses over to a second and creates a situation that is sufficiently different from the one foreseen by the original author of the second network, some additional nodes may have to be constructed to enrich the later portions of the second net to reflect more plausibly the new conditions.

This problem of network elaboration as a result of a cross-over from one network to a second occurred only once in the 52 FORECAST 90 networks. In that instance, an occurrence in a military network that crossed over to a political network called for the generation of additional nodes in the political network to reflect the changed military situation.

Where these additional network branches are created in response to some change in conditions brought about by a cross-over from another network, it is very useful to designate the new branch that has been created through an entry in the network notes compendium (the "Network Note Book" mentioned in Chapter 2 in which the notations on the substantive materials presented or rejected for specific nodes are kept). These node notes can then be used to designate the consideration of a specific new branch or branches of a network based on a contingent occurrence of an event or events from another network.

It is generally the case that additional networking produced by a particular cross-over can be reduced through careful initial network construction. Thus, additional networking had to be undertaken in only one of the 52 existing FORECAST 90 networks because systematic consideration was given, following the instructions presented in Chapter 2 of this manual, to developing an envelope of alternatives that encompassed both the greatest increase and the greatest decrease in the trend under examination. Where the ranges of plausible outcomes that might occur from the immediately prior node in the network were defined carefully, there may be little or no reason to have to undertake additional networking.

SUMMARY

This chapter has presented the last part of network construction and preparation for use in the FORECAST 90 computer programs. Network integration has been considered as a two-part task: definition of network cross-over points and assessment of the impact of nodes in one network on nodes in the second network. Network equivalence has been isolated through a coding system that locates the structurally similar features of the actions summarized in a node. Network impact is the product of an analyst's judgment on the relationship between two nodes that have been found to be structurally equivalent. The chapter ends with a review of several different types of network cross-overs found in the first 52 FORECAST 90 networks.

The last theme presented in this chapter -- a consideration of what is present in the existing networks -- provides the focus for the next chapter. There, an overview is presented of the extent to which the existing networks cover the trends, determining factors, and geographic regions of the world.

5. NETWORK COMPLETENESS

The procedures for constructing, coding, and integrating the FORECAST 90 networks were implemented for 52 decision trees on economic, military, political, socio-psychological, and technological catalytic events. These networks demonstrate the applicability of the networking approach across a broad range of substantive and geographic areas and its capability to interrelate disparate phenomena. Additionally, the robustness of the networks was tested further by constructing the networks for global coverage and by treating a wide-ranging set of issues.

In this chapter the distribution of the 52 networks constructed in the contract phase of FORECAST 90 is discussed. This discussion focuses on network completeness, that is, the extent to which the 52 networks cover the trends and determining factors selected as the focus of tree construction. Thus, the more networks there are for a trend or determining factor, the more complete is the network coverage for that area.

The principal reason for considering network completeness is to present information in a single location on the trends and determining factors that have had relatively more or relatively fewer networks written for them. With this information, additional work on network construction can be focused on subject areas where fewer networks exist. Similarly, an examination of the extent to which the 52 networks focus on different geographic regions will aid consideration of the development of new networks.

To review existing work and to direct future network construction, the completeness of the 52 existing networks is discussed in this chapter. Network coverage by trend is presented first; network coverage by determining factor is examined second. Network coverage by geographic region is then considered. Finally, the degree of integration among the networks is assessed. A discussion of the procedures for monitoring the

current status of the networks in the system and the coverage of those networks by various categories of behavior concludes the chapter.

COVERAGE OF THE NETWORKS BY TREND

Table 1 shows the distribution of the networks across the five economic, military, political, socio-psychological, and technological trends. Approximately one-third of the networks deal with the military trend. Nearly 60 percent of the networks treat either the military or the political trends. Proportionately fewer networks deal with the socio-psychological or the technological trends.

TABLE 1
Frequency of Networks by Trend

<u>Trend</u>	<u>Frequency of Occurrence</u>
Economic	9
Military	17
Political	13
Socio-Psychological	6
Technological	7

This distribution of networks by trend reflects a judgment of the relative importance of the subject areas for national security planning. Politico-military questions dominate the world of the military planner, analyst, and decision-maker. Hence, they are more heavily emphasized in the 52 networks constructed for FORECAST 90.

COMPLETENESS OF THE NETWORKS BY DETERMINING FACTOR

The determining factors are representative components of a specific trend that can be studied more concretely. A set of determining factors was identified for each of the five trends. Trends added at a later date will require individual sets of determining factors. Table 2 through 6 list the determining factors for each of the five trends utilized in the initial FORECAST 90 network research and the networks constructed for each.

TABLE 2
Economic Interdependence

<u>Number</u>	<u>Determining Factor</u>	<u>Networks</u>
01	An Adequate Supply of Basic Resources to Meet Existing Demands	E010101 E010102 E010103 E010104
02	Availability of Markets for Established Industrial/Processed Goods	E010201
03	Stability of International Monetary/Financial System	E010301 E010302
04	Continuation of Absolute and Relative Inequalities in Distribution of Economic Factors	E010401
05	Policies Reflecting the Recognition of the Benefits Accruing from Unencumbered International Trade	E010501

TABLE 3

Utility of Force

<u>Number</u>	<u>Determining Factor</u>	<u>Networks</u>
01	Relative and Absolute Strategic Nuclear Capabilities of Major Actors	M010101
02	Balance of East-West Tactical and Conventional Forces	M010201
03	Capabilities of Major Powers to Establish, Maintain, and Utilize Significant Bases for Military Operations Outside Their National Geographic Boundaries	M010301 M010302 M010303 M010304 M010305 M010306 M010307
04	Percentage of GNP Committed by Major Powers to the Development and Maintenance of Military Capabilities	M010401 M010402 M010403 M010404
05	Extent and Sources of Military Aid or Military Sales Programs in LDC's	M010501 M010502
06	Development of Militarily Significant Nuclear Capabilities by Nations Not Previously Equipped	M010601 M010602

TABLE 4

Detente

<u>Number</u>	<u>Determining Factor</u>	<u>Networks</u>
01	Continued Progress Toward Global Economic Interpenetration	P010101
02	Stability of Current International Alliance Patterns	P010201
03	Pragmatic, as opposed to Ideological, Orientation	P010301 P10302 P10303
04	Absence/Presence of Significant Conflicts in which Major Power National Interests are Directly Involved on Opposing Sides	P010401
05	Situations Presenting Significant Opportunities for Major Powers to Increase an Expanded Influence	P010501
06	Presence of Mutual Deterrent Capability Between the United States and Soviet Union	P010601
07	Level of Soviet/Chinese Tension	P010701
08	Stability of Absolute and Relative Nuclear Weapons Distribution	P010801 P10802
09	Level of Developed/Developing/Under- developed Tensions	P010901

TABLE 5

Sense of World Community

<u>Number</u>	<u>Determining Factor</u>	<u>Networks</u>
01	Role, Scope, and Influence of Supernational Organizations	S010101
02	Role, Scope, and Influence of Regional International Organizations	
03	Continued Progress Toward Global Economic Interpenetration	S010401
04	Level of Global Social Communi- cation and Transnational Social Interaction and Exposure	S010501 S010502
05	Impact of Availability of Resources on Attitudes Toward Cooperation and Conflict	S010601
06	Impact of Race, Cultural, Linguistic Differences of Attitudes Toward Cooperation and Conflict.	S010701
07	Impact of Ideological Differences on Attitudes Toward Cooperation and Conflict	

TABLE 6

Rate of Change in Technology

<u>Number</u>	<u>Determining Factor</u>	<u>Networks</u>
01	Availability of Investment Capital	T010101
02	Universal Belief that Science and Technology are Key Elements for Advancing the Quality of Life	T010201 T010202 T010203
03	Government Support for R&D	
04	Continued Growth and Adaptation of Educational Systems	
05	Degree of Efficiency of Information Exchange	T010501
06	Major Social, Ecological, and Environmental Opportunities for Applying Technology	T010601 T010602

In constructing the networks, an effort was made to cover a range of determining factors for each trend. Thus, networks were constructed for 29 of the 33 determining factors developed for the five economic, military, political, socio-psychological, and technological trends. At least one network was written for each determining factor for economic interdependence, utility of force, and detente. Networks were also constructed for five of the seven determining factors for sense of world community and four of the six determining factors for the rate of technology. .

Two determining factors for the socio-psychological trend -- the role, scope, and influence of regional intergovernmental organizations and continued progress toward global economic penetration -- did not have networks related specifically to them. Similarly, two determining factors for the technological trend--government support of research and development and continued growth and adaptation of educational systems -- are not covered by a network. These omissions reflect, in part, judgment that these four factors are stable components of the international system and interruptions of their influence are generally implausible.

All other determining factors are covered by at least one network, and several determining factors have more than one network constructed for them. In particular, the determining factors for the utility of force dealing with base rights and the allocation of resources to national defense are densely covered. Seven nets were constructed for the determining factor of the military trend that deals with the military basing capability of major powers. Since there are substantial indications that the forward basing positions of major powers are currently in flux, this determining factor was emphasized.

The commitment of resources by major powers to the development and maintenance of military capabilities is a second determining factor for the military trend that has a large number of networks. Four of the 17

military nets focused on this question to emphasize the importance of the issue based on the presently shrinking defense-related shares in industrial economies.

A similar concern for availability of needed resources is reflected in the most extensively treated determining factor of the economic interdependence trend. Four networks (out of nine) focused on the concern for an adequate supply of basic resources to meet existing demands.

COVERAGE OF THE NETWORKS BY GEOGRAPHIC REGION

An effort was made to construct networks for catalytic events that had a broad geographic focus. As shown in Table 7, all except one of the geographic regions used by the Joint Chiefs of Staff for planning purposes are covered in the 52 FORECAST 90 networks. The sole geographic region that is not covered in the existing networks is the polar region.

TABLE 7
Frequency of Networks by Geographic Area

<u>Area</u>	<u>Frequency of Occurrence</u>
North America	14
Western Europe and Atlantic, Pacific	11
East Asia	10
Soviet Union/Eastern Europe	5
Middle East	4
Central and South America	2
South Asia, Indian Ocean, Sub-Saharan Africa	2
Space	1
Polar	0

Not surprisingly, geographic coverage is concentrated on three of the nine regions, as North America, Western Europe, and East Asia each have

10 or more networks. Given the focus of U.S. security concerns over the last 10 years and the plausible directions of U.S. security interests in the next 10 years, this concentration is quite realistic. All other regions have fewer than six networks written for them.

The figures on geographic coverage, however, are misleading if not carefully interpreted. The figures represent only the focus of the catalytic event on which the network is based. They do not accurately represent the range of geographic areas affected by the event. For example, although only five nets were built for catalytic events that focus on the Soviet Union, each of the 52 networks in fact considers the impact of the catalytic event on which it is based for U.S./Soviet relations. Hence, the geographic coverage of the networks is, if anything, considerably understated in Table 7.

Table 8 cross references the 52 networks by the trend (economic, military, political, socio-psychological, and technological) and the geographic region used in JCS planning. The table documents the effort to attain coverage across all combinations of trends and geographic regions. Particular note should be taken of the catalytic events listed in the table in parentheses. These entries represent catalytic events (and networks) that do not clearly fall into a single geographic region. For example, the impact of Third World militancy at the United Nations on the sense of world community involves countries from at least three different geographic regions. Hence, the network is listed in each of the three areas.

The economic and military trends tend to cover the JCS geographic regions more completely. Catalytic events for detente have been examined in all world areas except South Asia, the Indian Ocean and Sub-Saharan Africa. Networks treating the socio-psychological trend cover five of the seven global regions, but no socio-psychological networks have been constructed for North America or the Soviet/Eastern European regions. The technological networks are distributed on narrow geographical grounds, covering

TABLE 8

Cross-Listing of Networks by Trend and Region

	<u>Economic</u>	<u>Military</u>	<u>Political</u>	<u>Socio-Psychological</u>	<u>Technological</u>
North America	<ul style="list-style-type: none"> • Grain Embargo • U.S. Recession 	<ul style="list-style-type: none"> • Surface Effects • Ship-to-Shore Logistics • Nuclear-Powered Airship • U.S. Reduces Defense Budget • U.S. Troop Reduction in Europe 	<ul style="list-style-type: none"> • U.S. Leadership • Assassination • U.S. Grain Embargo • U.S. Raw Materials 		<ul style="list-style-type: none"> • Research Costs Increase • Nuclear Fusion • Weather Modification
Central and South America	<ul style="list-style-type: none"> • Cartelization of copper • (Multilateral Aid)^a 	<ul style="list-style-type: none"> • (Arms Sales Competition) • (LDC's Switch from U.S. to USSR/PRC for Aid) 	<ul style="list-style-type: none"> • Argentina Nuclear 	<ul style="list-style-type: none"> • (Third World, UN) 	
Western Europe, Mediterranean, Atlantic	<ul style="list-style-type: none"> • EEC Autonomy • EEC Integration • EEC Breakdown 	<ul style="list-style-type: none"> • EEC Autonomy • Loss of Mediterranean Bases. • European Military Integration • (U.S. Troop Reduction in Europe) 	<ul style="list-style-type: none"> • EEC Autonomy • Italian Communist Government 	<ul style="list-style-type: none"> • EEC Autonomy • Italian Communist Government 	<ul style="list-style-type: none"> • EEC Autonomy • Nuclear Accident • (Research costs Increase)
Eastern Europe, USSR	<ul style="list-style-type: none"> • USSR-Japan Economic 	<ul style="list-style-type: none"> • USSR First Strike • USSR Defense Budget • USSR/PRC Increase Defense Budget 	<ul style="list-style-type: none"> • USSR leadership Change • USSR First Strike 		

^a Catalytic events listed in parentheses do not clearly fall into a single geographic region.

only three of the seven regions of the globe. Given the technological predominance of regions containing the more advanced nations, there is some justification for the focus of the technological networks on North America, Europe, and East Asia (Japan).

Moreover, it proved very difficult to identify plausible catalytic events for the less developed countries on the technological trend. However, many of the technological networks initiated by catalytic events that occurred in the developed regions exerted a major impact on Third World nations. Increased transfer of technology from developed to less developed countries illustrates this point. Thus, a technological breakthrough in weather modification is likely to occur in the developed countries but have even greater implications for the productive potential of the Third World.

COVERAGE OF NETWORK INTEGRATION

A final consideration of this chapter is the extent to which the networks are integrated with each other. A fundamental assumption of the FORECAST 90 project is that global trends are linked across subject areas. Therefore, it is important to assess the completeness with which networks for the five trends are intertwined. To this end, the integration of the networks has been examined by tracing the cross-over points between nets.

Appendix VIII presents a full list of the network to network cross-overs that met the criteria for network integration (that is, structural equivalence and substantive impact) discussed in Chapter 4. Highlights of this Appendix are presented in Table 9. One example of each type of cross-over that was observed in the 52 FORECAST 90 networks is displayed in the table.

Network integration produces a cross-over from every type of network to every other type of network for all but one category of cross-overs. As inspection of Table 9 will show, no instances of military networks crossing over to technological networks (or vice versa) were observed. In part,

TABLE 9

Examples of Network Cross-Overs^a

	<u>Network Type</u>			
	Economic	Military	Political	Socio-Psychological
Economic	E010101+ E010301	M010404+ E010102	P010102+ E010101	S010401+ E010301
Military	E010101+ M010301	M010401+ M010201	P010102+ M010601	S010502+ M010501
Political	E010101+ P010901	M010602+ P010901	P010102+ P010401	S010401+ P010701
Socio-Psychological	E010103+ S010401	M010501+ S010502	P010802+ S010401	S010401+ S010101
Technological	E010102+ T010101		P010303+ T010202	S010502+ T010201
				T010201+ T010501

^a The table's format is interpreted as follows. The entry E010101+→E010301 is located in the first column, first row. This means that one or more of the nodes in the network E010101 (Oil Embargo) contain a *GO TO statement that refers it to one or more nodes in the E010301 (EEC Autonomy) network. All other table entries should be interpreted similarly. The occurrence of a blank on the table indicates that there were no cross-overs of that type.

this was due to the type of catalytic event that was networked for the technological trend. These events were generally breakdowns of technology rather than the creation of some research and development advance that might have military implications. Moreover, several of the military networks are actually representations of the implications for the utility of force of specific breakthroughs in military technology. For example, included in the military networks are technological breakthroughs for nuclear-powered airships, advanced surface-effects ships, and new logistical technologies that have an important impact on the utility of force.

With this sole exception, there is at least one instance in which each type of network is tied to each other type of network. Every one of the 52 networks has either another network that references it through a GO TO statement or that it references with a GO TO. Thus, there is considerable integration in the 52 FORECAST 90 trees.

MONITORING THE NETWORKS AVAILABLE IN FORECAST 90

Fifty-two networks have been written and stored at the USAWC as part of the FORECAST 90 effort. Details of the procedures for constructing and coding these networks are presented in Chapters 2-4. In this chapter we have discussed the extent to which important trends, determining conditions, and regions of the globe have been covered with these 52 networks.

Beyond describing the construction of networks for FORECAST 90, it is important to introduce potential users to the computer programs that have been written for these nets. Although these programs are discussed in greater detail in the "User's Guide to the FORECAST 90 Computer Programs," one program is particularly central to the operation of the FORECAST 90 networks by an individual who is unfamiliar with the information available in the existing 52 networks. Hence, one of the FORECAST 90 programs -- NET4 -- is described briefly here.

NET4 is a computer program to introduce users to the substantive details of the FORECAST 90 networks. It provides a means for someone who is not

familiar with the available networks or the range of available subjects in the existing networks to obtain this basic information in a variety of forms. Once this information is obtained, the user can seek additional information through the other programs in the FORECAST 90 system. Alternatively, a user may decide that the existing networks do not cover the subject(s) that he needs, and perhaps may turn to Chapters 2-4 for information on how to construct a new network.

The program permits one to obtain information for each network in the system on:

- Tree number
- Author of the tree
- Date of tree creation
- Date of last tree modification
- Total number of nodes in the tree
- Main actor in the catalytic event on which the tree is based
- Substantive topic on which the tree is based
- Geographic region in which the catalytic event occurs
- One line of text describing the catalytic event

Any interested user can either obtain this information for each network or for a specified subset of networks. For example, if someone is interested only in those networks dealing with the Middle East and North Africa, only summary information on the networks that focus on the Middle East will be printed. If someone is interested in all networks written after a certain time point, this information can be searched for and printed.

Any single part or combination of parts of these information categories can be used to inquire about available FORECAST 90 networks by using the NET4 program. To make such a search, the user simply specifies what information is needed about what network or kinds of networks. After the search, a brief description of the contents of those networks that have been searched for will be printed.

Networks are stored in the computer files at the USAWC under a unique name for each network. The NET4 program lists the file number under which each network is stored. This number is the same as the number in the tree for the catalytic event. For example, the economic network on an oil embargo by the Arab states against the industrial world is stored under the number E010101--an alphabetic-numeric sequence that is also the number of the catalytic event for the network. Thus, by running the NET4 program an individual can obtain information on how the networks that are available generally or that are of interest to him are stored for computer use. Alternatively, a list of all catalytic events networked (and thus the number under which the network is stored) is presented in Appendix I.

SUMMARY

The extent to which the trends and the determining factors identified in FORECAST 90 have been covered by the 52 decision networks is reviewed in this chapter. Additionally, the geographic spread of the networks across the regions used by the JCS in contingency planning was discussed. Finally, the extent of integration in these 52 networks has been considered.

The analysis suggests that the trends and determining factors isolated in Chapter 2 have been extensively covered. A number of networks are available for each of the five trends, and military and political networks--areas central to the national security concerns of the armed forces--have been stressed. Moreover, almost all of the determining factors within the five trends have been given considerable attention in the existing networks.

Having reviewed how the networks are to be constructed, coded, and prepared for use in the FORECAST 90 computer programs, the final chapter deals with the use of these networks in the forecasting and planning communities. In other words, the next chapter examines how the networks might be used to aid planning and forecasting in the armed forces.

6. UTILIZATION OF NETWORKS IN THE FORECASTING AND PLANNING COMMUNITIES

Chapters 2-4 of this manual have focused on how to design, write, code, and integrate networks such as those constructed for FORECAST 90. Chapter 5 dealt with how completely the existing 52 networks covered the trends and determining conditions isolated for treatment in FORECAST 90. In these chapters, the role of FORECAST 90 as a methodology to examine the plausible downstream implications of a significant event has been stressed. In short, FORECAST 90 centers on the impact of major events and not on predicting what the world will actually look like in 1990.

This chapter focuses on the use of the networks in forecasting and planning in national security affairs. In other words, now that the dynamics of network construction have been reviewed, attention will shift to network utilization. Nine functional areas in which the FORECAST 90 networks may be useful are discussed. An application of the networks to a specific problem is then developed to clarify these points. Finally, the chapter closes with a brief discussion of the potential problems that exist in using the networking procedures developed for FORECAST 90 for forecasting and planning.

SOME FUNCTIONAL AREAS IN WHICH THE NETWORKS CAN BE USED

The networking procedures developed for FORECAST 90 permit analysts to deal with alternative outcomes generated by major, disruptive events. They may also suggest ways in which the probability of achieving the desired outcomes could be influenced by previous actions. Since the areas that can be handled by this networking procedure cut across all facets of national strategic interest, the networks may prove valuable to any government planner, but particularly to elements of the Department of Defense. In this section, applications of the FORECAST 90 approach to specific functional areas are covered.

The FORECAST 90 networking procedures hold potential for describing the downstream effects of major events and for contingency planning in at least nine areas:

- National policy determination
- Intelligence estimation
- Readiness planning
- Logistics
- Military personnel planning
- Civilian personnel planning
- Reserve components planning
- Budget development and execution
- Research and development

Together, these nine areas encompass the world of the planner (who must act on what the forecaster or the decision-maker has given him) and the decision-maker (who must select from a set of alternatives given him by his staff).

FORECAST 90's methodology can suggest areas on which information gathering (intelligence) should be focused. Logistics, readiness planning, and manpower utilization can be aided by the networking procedure as the logistical implications of various courses of action laid out in the networks can be assessed. Similarly, obtaining the downstream effects of an event should assist planners in defining the manpower requirements, including the possible need to involve reserve units. Information on alternatives suggested through the FORECAST 90 networking methodology may channel research and development efforts that are required to meet a potential downstream situation.

Fiscal planning and budgeting can be aided by the networking procedure. For example, the networking approach in FORECAST 90 may suggest some

contingencies that must be budgeted. Moreover, the constrained budget may dictate that certain alternatives available in the networks cannot be followed unless supplemental appropriations are made available.

The networking methodology used in FORECAST 90 is also applicable at the NCA/National Security Council level to display for decision-makers the impact of various policy alternatives on overall U.S. strategic interests. Since the networks describe a wide range of alternative futures, including events that would result if a significant change in current trends occurred, they can be used to suggest how to obtain a more desired outcome by following one policy rather than another.

AN EXAMPLE OF NETWORK APPLICATION

With a number of individual networks available, the user will find that there are many instances of nodes reflecting actual events or a range of possible actions/responses which may be common to two or more networks. Although the system can identify computer-recognized equivalencies between similar nodes in different decision networks, there will be other instances where, because of program limitations, personal judgment will be necessary to recognize relationships.

Use of the network system can alert the user to a spectrum of possibilities in connection with any situation he has under study. Further, it will enable him to array them in a logical, sequential display which will assure consideration of interrelated events and responsive actions which the system reflects.

Application of this capability is demonstrated by the following example which is initiated by the receipt of typical information by the Army staff, highlights Army staff reactions, and leads to additional related networks, each of which develops further patterns of related events and further responsive actions. The example shows the interrelationship of networks in three separate substantive areas:

MO10404 - Increase in Soviet/PRC Application of Resources
to Develop Increased Military Capabilities

E010102 - U.S. Embargo on Grain and Soybean Exports

P010102 - U.S. Embargo on Grain

These lead to two additional networks which, because of their complexity, are not pursued to completion in this example:

E010101 - Oil Embargo by OPEC Nations

E010501 - EEC Breakdown

A well-developed, fully functioning network system would be a valuable adjunct to operations and planning for the Army staff. Such utility can be demonstrated by considering a hypothetical, but plausible, example which is covered by some of the catalytic events already developed into decision networks for the FORECAST 90 effort.

Assume that in the summer of 1977, during the course of routine intelligence collection, sources detect that the Soviet Union and the People's Republic of China appear to be placing greater emphasis and resources on the development of increased military capabilities. With greater collection effort, solid evidence is obtained that this is true and intelligence reports on the development are forwarded to the Army staff. Such an intelligence report might read as the one in Table 1.

At approximately the same time, a devastating epidemic of stem rust that attacked the U.S. wheat crop results in an anticipated loss in yield which agricultural commodity experts estimate may run over 25 percent of U.S. annual grain production. In addition, the soybean crop has been damaged by adverse weather conditions and production will be far from normal. The Wall Street Journal covers the situation in detail and reports that the U.S. Secretaries of Agriculture, Commerce, and State have agreed that the United States must curtail exports in order to preserve U.S. resources. Accordingly, the United States established an embargo on the export shipments of grain and soybeans. Table 2 summarizes these developments.

TABLE 1

Extract from Intelligence Update - 1 July 1977

Soviet Union

The Ministry of Production has directed reduction in the production of consumer items in the heavy appliance and electronic fields. This was done despite rising consumer demand for such items.

Unconfirmed reports are that some production lines in plants east of the Urals are being modified to shift from consumer items to military hardware. Materials supportive of nuclear strike and air transportability capabilities are reported as the new products being produced on these lines. The reports are supported by known earlier Soviet decisions to increase allocation of resources to military programs.

People's Republic of China

The People's Republic of China has greatly increased its efforts to expand its ICBM capability and its nuclear warhead inventory.

Net reports show China moving some troop units from bases on the Soviet border to bases in southern Inner Mongolia near identified test and development centers.

TABLE 2
United States Establishes Embargo
on Export of Grain and Soybeans

At a press conference yesterday the U.S. Secretary of Agriculture announced that an embargo had been established on the export of grain and soybeans produced in the United States. Other members of the cabinet, including the Secretaries of State and Commerce, have agreed that this move is necessary in view of the critical situation with respect to this year's crops which are estimated to be more than 25 percent less than normal. The anticipated shortage is a direct result of the devastating epidemic of stem rust which has developed in the wheat-producing states and of the adverse weather conditions which have affected soybean production. Export commitments cannot be met without restricting even more seriously domestic consumption and further forcing increased prices of foodstuffs.

These events--seemingly unrelated--may, in fact, require actions or decisions that draw them together and force interaction. Availability of the network system will permit the planner to visualize such possibilities and test alternative courses of action at each stage as the situations develop.

Thus, by consulting the available network list and exercising the computer-search capability the user can determine applicable networks, print them out for study, and pursue the various possibilities indicated to determine the most desirable course(s) of action. Such a search of existing networks would indicate that network E010102 deals with potential actions/responses by the Soviet Union to the grain embargo. These responses are given in Figure 1.

Let us assume that the planner considers that the second option displayed the most likely one to occur, given recent Soviet experience with crop

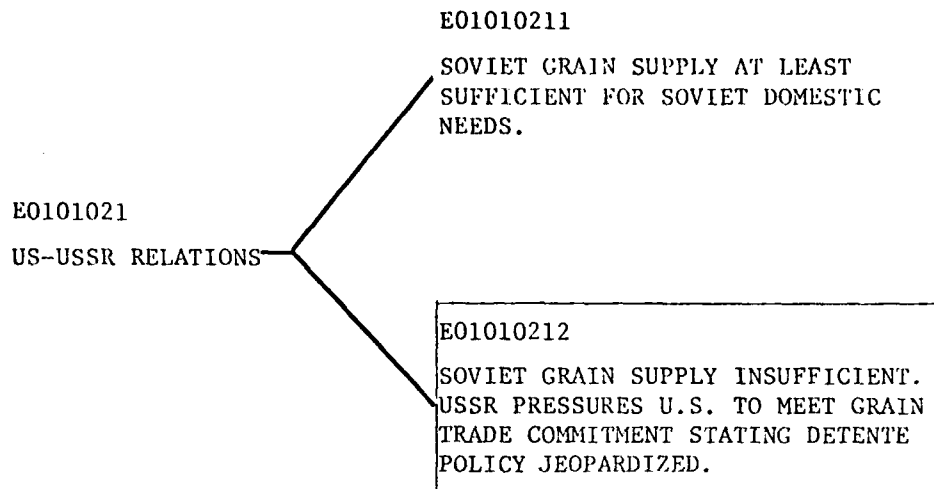


Figure 1. Some Effects of a U.S. Grain Embargo on U.S./Soviet Relations.

shortfalls. While the planner has concluded that this is the most likely Soviet response to the situation, it should not necessarily be considered the optimal choice for the United States.

A similar search of the existing networks would show a network on the political implications of a grain embargo. Thus, the computer search has indicated that network P010102 is obviously interrelated with E010102 as shown in Figure 2.

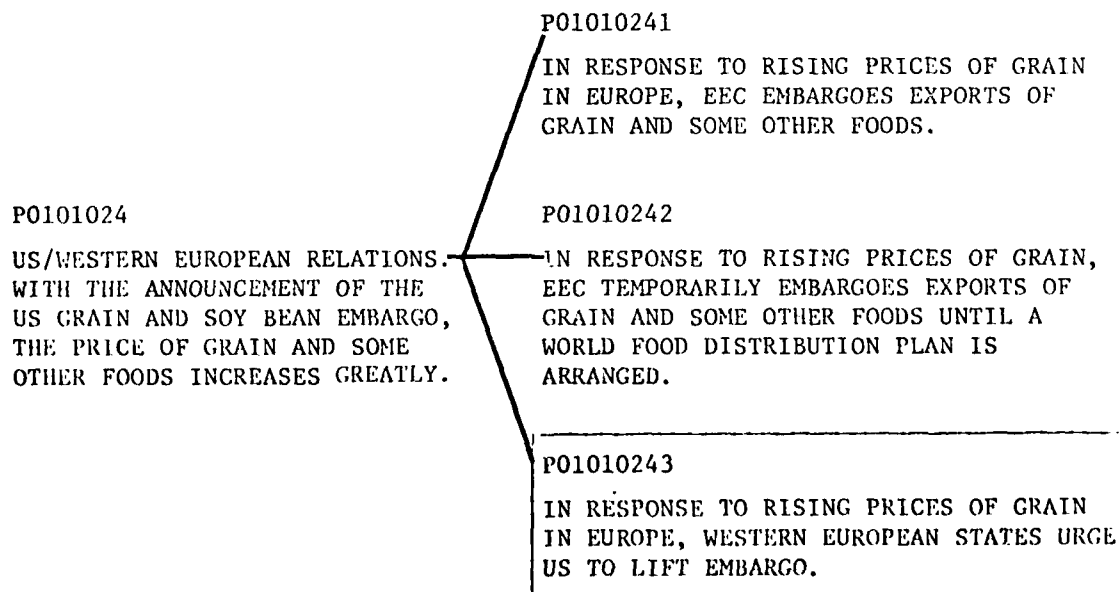


Figure 2. Western European Reactions to a U.S. Grain Embargo.

Here the planner follows a similar course with respect to Western European nations as was indicated for the Soviet Union in the previous network. This, in effect, is an integration of the flow of actions in these two networks.

The planner can also check for possible cross-overs to other networks. Doing this will turn up the network M010404 which covered the increased emphasis by the Soviet Union and People's Republic of China on developing additional military capabilities. This network relates directly to the intelligence reports being received on Soviet/Chinese actions. One of the first considerations for this cross-over is the question of U.S.-Soviet relations. Three possible choices of Soviet response are presented in Figure 3.

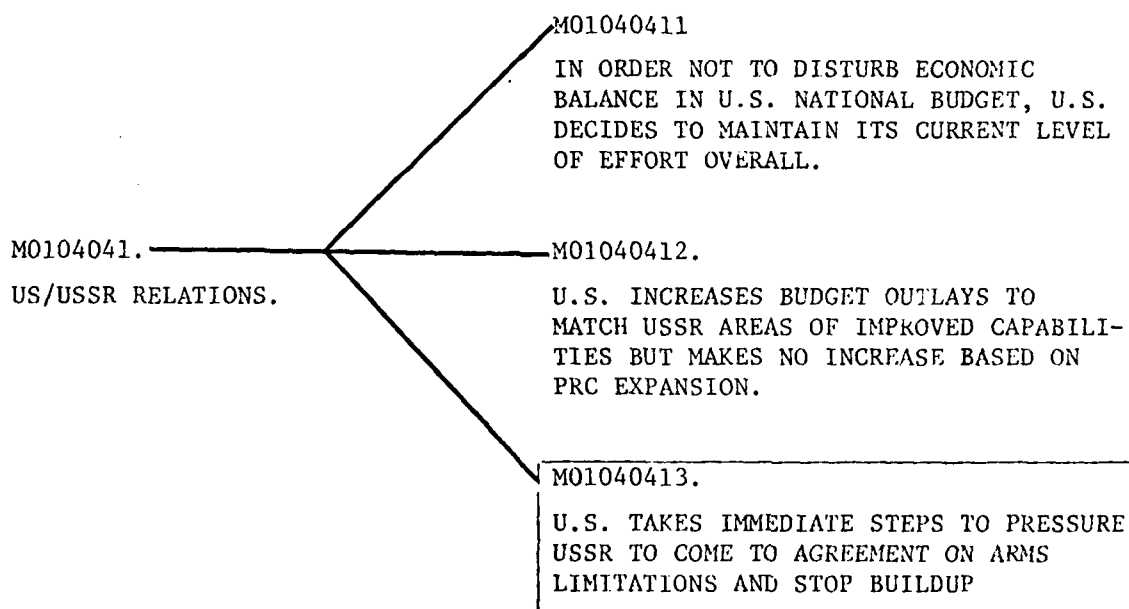


Figure 3. U.S. Reactions to Soviet Military Build-up.

Let us assume that the user chooses the third option in which the United States takes immediate steps to pressure the Soviet Union. Remember that this choice is not necessarily the optimal choice, but rather a choice that appeared attractive given the available information and available

options presented to the planner for his consideration. Moreover, it demonstrates a possible option that can cross over to other decision networks to show the planner the implications of alternative choices for different subject areas.

The option chosen is one in which the United States pressures the Soviet Union to stop its military build-up. This action is chosen as a cross-over response to the previous Soviet pressures that the United States lift its grain embargo. Thus, what were previously seen as dissimilar topics have begun to converge.

First, in the economic network, an action has occurred in which the Soviet Union breaks economic relations with the United States as a result of U.S. refusal to lift the grain embargo. Second, in the military network, the Soviet Union has rejected pressure from the United States to stop its military buildup. The Soviet response in the military arena may be a logical complement to the break in economic relations.

The network indicates that the Soviet Union has justified the buildup because of the threats posed by the People's Republic of China. If the Soviet justification is accurate, a number of options are open to the United States. If it is merely a propaganda cover for a planned buildup directed toward the West, then the first event may signal the early stages of a U.S.-Soviet crisis. Should these events signal a crisis, all agencies of the Army staff need to increase their planning and preparedness.

Although hypothetical, the events presented in this example could plausibly occur. Should they occur, and should a network system such as FORECAST 90 exist, the planners could call up the networks, consider their alternatives, and play out the situation(s) along different lines. Alternatively, the exercise could be purely an analysis conducted for planning purposes to investigate numerous strategic alternatives. Whichever path is followed, results such as those shown in Table 3 are obtained.

TABLE 3
Listing of Occurrences Over Time By Network

EO10102	SOURCE & SUBSEQUENT EVENTS/RELATED ACTION(S)	EVENTS	SOURCES & SUBSEQUENT EVENTS/RELATED ACTIONS.	EVENTS	EO10102	SOURCES & SUBSEQUENT EVENTS/RELATED ACTIONS.
2a. U.S. grain crop down 25% (Wall Street Journal). U.S. threatens to cut grain exports (EO1010212). (Not used: EO1010212; EO1010213)	Article in Wall Street Journal, with press releases from Commerce and Agriculture. Downstream network event. Go to EO1010243	1. Solid evidence received of marked increase in USSR/PAC resources being applied to developing increased military capabilities. (NO10404)	Intelligence reports, diplomatic confirmation. All staff planning agencies alerted to watch build-up.	2b. U.S. grain crop down 25% U.S. terminates grain export (EO101021)	Article in Wall Street Journal, with press releases from Commerce and Agriculture. Downstream network event. Re-lates to USSR pressure on U.S. to meet commitments. Go to EO1010212.	
3a. USSR pressures U.S. to meet commitments (EO1010212) (Not used: EO1010212; EO1010213)	Downstream network event. Re-lates to U.S. pressure on USSR to stop build-up. Go to NO1040413	4. U.S. pressures USSR to stop build-up and agree on arms limitations. (NO1040413)	Possibly related to request from USSR to restore grain shipments. (Go to EO1010212)	3b. Price of grains and food increases greatly in Europe and West Europe urges U.S. to lift embargo (EO1010243) (Not used: EO1010241 and EO1010242).		
3a. U.S. refuses to restore grain exports (EO1010212) (Not used: EO1010212; EO1010213)	Downstream network event. Re-lates to U.S. pressure on USSR to stop build-up. Go to NO1040413	6. USSR rejects U.S. proposal. Asserts build-up is for defense and deterrence against PAC. (NO10404131).	Action is logical complement to action by USSR to break economic relations and retaliate for U.S. canceling grain exports. (Stems from EO10102122). U.S. would increase intelligence effort to verify.			
7. USSR breaks economic relations with U.S. Threatens to retaliate by cutting of chromium, titanium, platinum (EO1010212) (Not used: EO1010212)	Downstream network event. Re-lates to USSR rejection of U.S. pressure with rationale that build-up is defense against PAC. Go to NO10404131.	8. U.S. determines USSR's assertion is false. Soviet build-up is not solely for defense against PAC. (NO104041312).	Triggers action among all agencies to initiate planning or increase effort underway. INTELL - Step up collection and evaluation effort. Concentrate on areas indicated. PERSONNEL - Plan possible U.S. build-up (procurement, training, etc.). LOGISTICS - Determine eqpt. status - check production capabilities - investigate facilities reqts. RESERVE COMPONENTS - Update mobilization plans - evaluate unit readiness. BUDGETARY - Determine fund reqts. review program.			
					9. OPEC threatens oil embargo and EPC backs oil embargo against U.S. (EO101024312)	Downstream network event. Go to EO1010212. Oil embargo and to EO1010212. EPC Presses Down

CONCLUDING COMMENTS ON THE FORECAST 90 APPROACH

In this chapter specifically, and in this manual generally, the usefulness of the FORECAST 90 methodology for forecasting and planning affairs has been emphasized repeatedly. There is little doubt that, once constructed, coded, and integrated in the manner discussed in the earlier chapters, utilization of the FORECAST 90 networks considered in this chapter can potentially play an important role in Army planning. The FORECAST 90 approach promises to produce a new and importantly different orientation to planning that has not been applied systematically in the past. Hopefully, the addition of the insights gained from FORECAST 90 networks will bring the work of the forecaster and the planner into closer coordination.

However useful, the FORECAST 90 networking procedures are not without their shortcomings. First, the networks are currently written on general problems with a global perspective, and are not focused on the problems that face armed forces action officers. To be of greater use to the officers who must respond on a quick reaction basis, the networks must be elaborated to deal with many more economic, military, political, socio-psychological, and technological trends.

Second, no evidence is available on whether the FORECAST 90 networks do actually reflect the "real world"--that is, whether the results suggested in the networks will actually be obtained should the event networked or a similar event ever occur. Hence, some actual, concrete applications of the networking procedures to a specific, focused problem may be a useful avenue to follow to test network validity.

Third, the present networks generate numerous decisional outcomes. At the present time, however, no decision rule is available in the networks to permit the decision-maker to select one optimal decisional outcome over the others. In part, this is the result of the absence of magnitudes for the decisional outcomes, where the only mention of the outcome is that the trend increased, decreased, or was maintained. Even with more precise measurement of the trends in the outcome column, some means--such

as game theoretic solutions--should be sought to summarize the outcomes and select the best course of action for a country.

These problems simply represent additional finetuning to an approach that has only begun to be fully developed. Each is a problem area that, with additional attention, can be overcome. Even in their present form, however, the decision networks generated in the FORECAST 90 format promise to be very useful additions to the tools available to members of the forecasting and planning communities.

BIBLIOGRAPHY

- BROADBENT, D.E. (1971) Decision and Stress. London: Academic Press.
- BUCHANAN, J.M. (1965) "An Economic Theory of Clubs," Economica (February): 1-14.
- CACI (1975a) Stochastic Simulations of Long-Range Forecasting Models for Less Developed Regions. Interim Technical Report. Arlington, Virginia.
- ____ (1975b) Quantitative Indicators for Defense Analysis. Final Report. Arlington, Virginia.
- ____ (1974a) Quantitative Methods for Long-Range Environmental Forecasting: Long-Range European Projections. Final Report. Arlington, Virginia.
- ____ (1974b) Development and Experimental Application of International Affairs Indicators. Final Report. Arlington, Virginia.
- ____ (1973) Developing Technology for Analyzing PSYOPS Systems (DETAPS). Final Report. Arlington, Virginia.
- COASE, R. (1960) "The Problem of Social Cost," Journal of Law and Economics (October): 1-44.
- COELHO, G.V., D.A. HANBURG, and J. ADAMS (eds.) (1974) Coping and Adaptation. New York: Basic Books.
- COSER, L. (1956) The Functions of Social Conflict. New York: The Free Press.
- DEUTSCH, M. (1973) Resolution of Conflict. New Haven: Yale University Press.
- DOWNS, A. (1957) An Economic Theory of Democracy. New York: Harper and Row.
- ILCHMAN, W.F. and N.T. UPHOFF (1971) The Political Economy of Change. Berkeley: University of California Press.
- JANIS, I. (1972) Victims of Groupthink. Boston: Houghton Mifflin.
- MARSCHAK, J. and R. RADNOR (1972) The Economic Theory of Teams. New Haven: Yale University Press.
- MCCLELLAND, C. and G. HOGGARD (1969) "Conflict Patterns in the Interactions Among Nations," in J.N. Rosenau (ed.) International Politics and Foreign Policy: A Reader in Research and Theory. New York: The Free Press, Revised Edition.

- OLSON, M. (1965) The Logic of Collective Action. Cambridge: Harvard University Press.
- PAULY, M.V. (1967) "Clubs, Commonality and the Core: An Integration of Game Theory and the Theory of Goods," Economica (August): 314-24.
- RUSSETT, B., J.D. SINGER and M. SMALL (1968) "National Political Units in the Twentieth Century: A Standardized List," American Political Science Review 62: 932-951.
- SAMUELSON, P. (1954) "The Pure Theory of Public Expenditure," Review of Economics and Statistics 36: 387-389.
- SHERIF, M. (1966) In Common Predicament. Boston: Houghton Mifflin.
- SIMMEL, G. (1955) Conflict and the Web of Group Affiliation. New York: The Free Press.
- SMELSER, N. (1963) The Theory of Collective Behavior. New York: The Free Press.
- THOMPSON, B. (1974) FORECAST 90. Carlisle Barracks, Pa.: United States Army War College.

ECONOMIC NETWORK (E)

CATALYTIC EVENTS

<u>Number</u>	<u>Subject Matter</u>
E010101	Oil embargo. Western developed nations and Japan deprived of oil from Middle East.
E010102	A 25 percent shortfall in North American grain and soybean crops leads to U.S. embargo on grain and soybean exports.
E010103	The EEC, seeking increased military and economic independence from superpower politics, announces it intends to integrate its defense forces at a future date and concludes a series of extensive trade agreements with selected IDC's rich in raw materials in exchange for broad trade credits, arms sales, military assistance, and the transfer of technology.
E010104	Cartelization of copper exports. Copper-producing countries of Africa, Latin America, and Asia formulate a policy to increase (and maintain) the price of copper at a level 100 percent greater than the existing level.
E010201	Japanese and Russian economic cooperation. Trade pact establishes extensive involvements of the Japanese in developing Soviet energy and other resources and technological cooperation in the electronic and transportation fields.
E010301	European economic integration. Perceived material benefits from economic integration lead to efforts to remove artificial (government) barriers to economies in Europe.

Number

E010302

E010401

E010501

Subject Matter

Severe economic recession in the United States.

LDC's pressure developed countries for a new aid system.
LDC preference is for multilateral aid but demand untied aid.

EEC breaks down as strains on resource availability exacerbate political disputes arising from economic nationalism.

MILITARY NETWORK (M)

CATALYTIC EVENTS

Number

Subject Matter

M010101

The Soviet Union embarks on a program to achieve strategic nuclear superiority (including a first-strike capability) over the United States.

M010201

MBFR negotiations are unsuccessful, and the U.S. Congress mandates a reduction of U.S. forces in Europe to 50,000.

M010301

The United States loses all bases and air transit rights in Southern Europe and the Mideast.

M010302

As a result of increasing leftist group activities in Japan, the United States loses air and naval bases and air transit rights in Japan and Okinawa.

M010303

The United States loses air and naval bases and air transit rights in Thailand, the Philippines, and Taiwan as these countries become more pro-Chinese.

M010304

Marked increase in naval capability is achieved by the United States in developing surface-effects ships for deployment and support of U.S. forces overseas.

M010305

Development of improved "over-the-bench" and "ship-to-shore" logistics capabilities progresses to the point that U.S. bases can be rapidly established and maintained almost anywhere in the world.

M010306

Strategic airlift capability is enhanced through the development of nuclear-powered airships.

Number

Subject Matter

M010307

A U.S. Congressional mandate results in withdrawal of all U.S. forces in South Korea.

M010401

The Soviet Union, due to requirements on the economy placed by internal factors, significantly reduces its national defense budget and its military manpower.

M010402

The EEC, seeking increased military and economic independence from superpower politics, announces it intends to integrate its defense forces at a future date and concludes a series of extensive trade agreements with selected LDC's rich in raw materials. These agreements involve guarantees of continuing supplies of raw materials in exchange for broad trade credits, arms sales, military assistance, and the transfer of technology.

M010403

Reduced credibility of the utility of military force, pressures for application of U.S. financial resources to social programs, worldwide depression and/or other factors force marked reduction in the national defense budget.

M010404

Solid evidence is received of a marked increase in the application of Soviet and PRC resources to develop increased military capabilities.

M010501

Arms sales competition results in entry of other nations capable of producing armaments (for example, Sweden) into programs with developing nations.

M010502

Nations now receiving military aid/sales from the United States cancel programs and turn to the Soviet Union or the People's Republic of China.

Number

M010601

Subject Matter

The People's Republic of China develops strategic delivery capabilities including land and sea-based missiles in significant quantities.

M010602

The countries of Western Europe coalesce politically to the point of integrating defense policies. The French and British nuclear deterrents are merged, and the combined EEC financial resources are put behind a major strategic and tactical nuclear weapons expansion program.

POLITICAL NETWORK (P)

CATALYTIC EVENTS

Number

Subject Matter

P010101

The United States adopts a policy of independence from foreign sources for critical materials. Extensive mining of the seabeds is planned.

P010102

U.S. imposes a grain embargo.

P010201

A coalition government that includes Communist participation takes power in Italy. The Italian Communist Party ascends to power in an Italian coalition government. Italy takes a non-aligned position in world politics; it loosens ties with NATO by a defensive alliance with minimal military cooperation before a war breaks out, and requests that all NATO and non-Italian troops, ships, armaments, weapons, planes, and material be removed from Italian territory. The new Italian Government declares that in foreign policy it will not align with any power but will pursue purely Italian interests.

P010301

The U.S. Secretary of State is assassinated by a member of a Soviet-sponsored terrorist group.

P010302

Soviet leadership changes increase the importance of ideology.

P010303

The U.S. leadership changes and a president is elected who insists on Soviet domestic changes as a precondition to U.S. cooperation.

Number

Subject Matter

P010401

A war breaks out in the Middle East. Israel attacks Syria. The attack is either preemptive or a response to Syrian antagonism. Egypt initially mobilizes but gives Syria only diplomatic and verbal support. Arab oil-producing nations cut off shipments of oil to states not supporting Syria. Non-Arab oil states take advantage of the situation by raising prices. The West is, therefore, faced with decreased supplies at higher prices. The United States and the Soviet Union concentrate ships in the Indian Ocean.

P010501

Iranian-Iraqi war. Iranian armed forces cross over into Iraqi Kurdistan to save the Pesh Merga (Kurdish guerrillas) from defeat. Iraq accuses the United States, Iran, and Israel of having invaded it and asks for Soviet and Arab support.

P010601

By maximizing the effectiveness of its superior missile throw-weight through MIRV warheads and by attaining an effective ASW capability, the Soviet Union develops a first-strike capability against the United States.

P010701

Activation of Sinkiang secessionist movement with Soviet assistance.

P010801

Japan decides to expand its armaments, acquire nuclear capacity, and enter the lucrative arms export market.

P010802

Argentina develops nuclear capability to counterbalance increasing Brazilian dominance of the continent.

P010901

The EEC, seeking increased military and economic independence from superpower politics, announces it intends to integrate its defense forces at a future date and concludes a series of extensive trade agreements with selected LDC's rich in raw materials. These agreements involve guarantees of continuing supplies of raw materials in exchange for broad trade credits, arms sales, military assistance, and the transfer of technology.

SOCIO-PSYCHOLOGICAL NETWORKS (S)

CATALYTIC EVENTS

<u>Number</u>	<u>Subject Matter</u>
S010101	Militant Third World nations successfully dominate the United Nations, destroying U.S. ability to influence policy in the organization.
S010401	The Soviet Union removes restrictions on the movement of people across the Iron Curtain.
S010501	There is a disastrous famine in India. Starvation intensifies concern over food resource availability throughout the world.
S010502	The EEC, seeking increased military and economic independence from superpower politics, announces it intends to integrate its defense forces at a future date and concludes a series of extensive trade agreements with selected LDC's rich in raw materials. These agreements involve guarantees of continuing supplies of raw materials in exchange for broad trade credits, arms sales, military assistance, and the transfer of technology.
S010601	A race war occurs in Africa between Black Africans and white Africans and Rhodesians.
S010701	Italy installs a coalition government including Communist participation. Balance of power in the Italian cabinet shifts to the left as the Communist/Socialist bloc controls the majority of votes.

TECHNOLOGICAL NETWORKS (T)

CATALYTIC EVENTS

<u>Number</u>	<u>Subject Matter</u>
T010101	Europe, Japan, and the United States experience a period of continued rising inflation, forcing the cost of research to unprecedented heights.
T010201	The EEC, seeking increased military and economic independence from superpower politics, announces it intends to integrate its defense forces at a future date and concludes a series of extensive trade agreements with LDC's rich in raw materials. These agreements involve guarantees of continuing supplies of raw materials in exchange for broad credits, arms sales, military assistance, and the transfer of technology.
T010202	A commercial nuclear power plant in Europe explodes, killing several hundred immediately and exposing more to varying amounts of radiation.
T010203	A 'killer' thermal inversion over Japan's industrial region kills thousands in the area.
T010501	The United States develops a fusion technology providing the relatively cheap generation of electricity but considers dissemination of the technology a political decision.
T010601	A direct broadcast satellite technology advances to the state where such a satellite could be launched.
T010602	The United States develops the capability to affect regional weather predictably.

ALPHABETICAL LISTING OF COUNTRIES AS ACTORS/TARGETS

<u>Number</u>	<u>Country or Group</u>
700	Afghanistan
161	Africa
405	African LDC's
339	Albania
615	Algeria
998	All Countries Other Than Superpowers
232	Andorra
589	Arab States
160	Argentina
161	Argentina & Peru
173	Arms-Exporting Nations
704	Asia
702	South Asia
704	Southeast Asia
899	ASEAN (Association of Southeast Asian Nations)
898	Asian LDC's (Asian People's Development Program)
900	Australia
305	Austria
400	Azores
771	Bangladesh
053	Barbados
211	Belgium
145	Bolivia
146	Bolivia and Peru
140	Brazil
141	Brazil and Chile
355	Bulgaria
775	Burma
516	Burundi

<u>Number</u>	<u>Country or Group</u>
811	Cambodia
471	Cameroun
020	Canada
699	CENTO
482	Central African Republic
483	Chad
155	Chile
710	China, People's Republic (PRC)
890	PRC and LDC's
891	PRC and N. Korea
892	PRC and Japan
893	PRC and People's Revolutionary Governments
713	China, Republic of
596	CIPEC (Intergovernmental Council of Copper Exporting Countries)
595	CIPEC and OPEC
100	Columbia
373	COMECON
383	Communist Parties
484	Congo
180	Copper Producers (All)
181	Copper Importers
094	Costa Rica
040	Cuba
352	Cyprus
315	Czechoslovakia
434	Dahomey
390	Denmark
994	Developed Countries (DC's)
042	Dominican Republic
130	Ecuador
398	EFTA (European Free Trade Area)
092	El Salvador

<u>Number</u>	<u>Country or Group</u>
530	Ethiopia
306	Europe, Eastern
397	EEC (European Economic Community)
215	Europe, Southern
397	Europe, Western
405	EEC, Northern Tier
406	EEC, Southern Tier
375	Finland
392	FAO (Food and Agriculture Organization)
175	Fertilizer Producers
177	Food Producers
986	Food Receivers/Imports
220	France
481	Gabon
420	Gambia
265	Germany, East
255	Germany, West
452	Ghana
350	Greece
090	Guatemala
458	Guinea
110	Guyana
041	Haiti
091	Honduras
310	Hungary
720	Hong Kong
362	IAEA (International Atomic Energy Agency)
395	Iceland
750	India
850	Indonesia
391	International Monetary Fund (IMF)
630	Iran

<u>Number</u>	<u>Country or Group</u>
631	Iran and Iraq
645	Iraq
205	Ireland
666	Israel
325	Italy
437	Ivory Coast
051	Jamaica
740	Japan
742	Japan and LDC's
743	Japan and Western Europe
663	Jordan
753	Kashmir
501	Kenya
731	Korea, North
732	Korea, South
690	Kuwait
812	Laos
099	Latin America
660	Lebanon
570	Lesotho
997	Less Developed Countries (LDC's)
989	LDC's, Anti- or Non-Communist
697	LDC's and OPEC
695	LDC's and Arab States
161	LDC's African
898	LDC's, Asian (Asian People's Development Program)
996	LDC's, Rich/Resource Rich
450	Liberia
620	Libya
621	Libya and South Yemen
223	Liechtenstein
212	Luxembourg

<u>Number</u>	<u>Country or Group</u>
721	Macao
999	Major Actors (US, USSR, PRC, Japan, W. Europe)
580	Malagasy
553	Malawi
820	Malaysia
852	Malaysia and Indonesia
782	Maldives
432	Mali
338	Malta
178	MNC's (Multinational Corporation)
590	Mauritius
435	Mauritania
172	Mercantile Countries
070	Mexico
610	Middle East
597	Middle East and North Africa
394	Migrants/Immigrants
989	Militant Third World
396	NATO
130	Non-Mercantile Countries
698	Oman
790	Nepal
210	Netherlands
989	New Majority at UN/Militant Third World
920	New Zealand
093	Nicaragua
436	Niger
475	Nigeria
185	Non-Arab Oil Producers
385	Norway
691	OAPEC (Organization of Arab Petroleum Exporting Countries)
199	OAS (Organization of American States)

<u>Number</u>	<u>Country or Group</u>
599	OAU (Organization for African Unity)
191	OECD
179	Oil Importers/Receivers
693	OPEC (Organization of Petroleum-Exporting Countries)
993	Other Cartels
909	Pacific Region
770	Pakistan
095	Panama
150	Paraguay
703	Persian Gulf States
135	Peru
840	Philippines
664	PLO (Palestine Liberation Org'n.)/Arab Guerrillas
290	Poland
235	Portugal
889	PRG's (People's Revolutionary Governments)
176	Raw Material Producers
174	Resource Importers
996	Resource Rich LDC's/Rich LDC's
889	Revolutionary Movements
552	Rhodesia
360	Rumania
517	Rwanda
670	Saudi Arabia
388	Scandinavia (Including Iceland)
992	SEATO
433	Senegal
451	Sierra Leone
830	Singapore
888	Sinkiang Secessionists
382	Socialist States
520	Somalia

<u>Number</u>	<u>Country or Group</u>
001	Some Nations/Selected Nations
560	South Africa
555	South Africa and Rhodesia
230	Spain
780	Sri Lanka
625	Sudan
572	Swaziland
380	Sweden
225	Switzerland
652	Syria
653	Syria and PLO
510	Tanzania
509	Tanzania and Zambia
800	Thailand
709	Tibet
461	Togo
052	Trinidad-Tobago
616	Tunisia
650	Turkey
500	Uganda
995	Undifferentiated Actor/Target
399	United Nations
365	Union of Soviet Socialist Republics
371	USSR & Japan & W. Europe
372	USSR & W. Europe
374	USSR & PRC
376	USSR & Japan
377	USSR & Arab Countries
379	USSR & LDC's
696	United Arab Emirates (UAE)
651	United Arab Republic (Egypt)
200	United Kingdom

<u>Number</u>	<u>Country or Group</u>
002	United States
190	US & USSR & W. Europe
191	US & Japan & W. Europe (OECD)
189	US & USSR & Oil Rich States
188	US & W. Europe & LDC's
192	US & USSR
193	US & PRC
194	US & Japan
195	US & W. Europe
199	US & OAS (Lat. Am.)
196	US & LDC's
439	Upper Volta
165	Uganda
101	Venezuela
102	Venezuela and Argentina
103	Venezuela and Peru
816	Vietnam, North
817	Vietnam, South
386	W. Europe and LDC's
387	W. Europe Except Italy (N.W. Europe)
389	W. Europe and OPEC
393	WHO (World Health Organization)
394	WTO (Warsaw Treaty Organization)
678	Yemen
681	Yemen, South
345	Yugoslavia
490	Zaire
491	Zaire and Mozambique
551	Zambia

ACTION TYPE CODES

<u>General Category</u>	<u>Specific Breakdown</u>
01 Accomplish	010 Achieve 011 Succeed 012 Solve 013 Resolve 014 Decide 015 Satisfy 016 Dominate 017 Control 018 Stabilize 019 Conclude
02 Accuse	020 Accuse 021 Denounce 022 Criticize/Decry 023 Warn 024 Threaten 025 Condemn 026 Resent
03 Acquire	030 Acquire 031 Produce 032 Buy/Procure 033 Take 034 [word omitted] 035 Receive 036 Invest 037 Overbid 038 Outbid
04 Aggravate Relationships	040 Aggravate 041 Expel 042 Revoke 043 Seize 044 Confine 045 Restrict 046 Purge 047 Irritate 048 Subvert
05 Agree	050 Agree 051 Accept 052 Accede 053 Allow 054 Permit 055 Encourage 056 Cooperate 057 Concur 058 Welcome

06	Approve	060	Approve
		061	Adopt
		062	Sponsor
		063	Promise
		064	Assure
		065	Reward
		066	Praise
		067	Recognize
		068	Assist
07	Change	070	Change
		071	Exchange
		072	Alter
		073	Develop
		074	Merge
		075	Join
		076	Realign
		077	Move Toward
		078	Retarget
08	Comment	080	Comment
		081	Express
		082	Declare
		083	Hint
		084	Signal
		085	Take Note of
		086	Question
		087	Reply
		083	Respond
		089	Express Concern/Express Displeasure
09	Conduct	090	Conduct
		091	Compete with/for
		092	Negotiate
		093	Export
		094	Import
		095	Trade with
		096	Bargain
		097	Manipulate/Play-Off
		098	Match
10	Consult	100	Consult
		101	Inquire
		102	Mediate
		103	Moderate
		104	Persuade
		105	Urge
		106	Discuss
		107	Communicate
		108	Study/Evaluate
		109	Advise

11 Decrease

110 Decrease
111 Lessen
112 Diminish
113 Reduce
114 Weaken
115 Split/Fail to Support
116 De-escalate
117 Dissipate

12 Deny

120 Deny
121 Refuse
122 Decline
123 Prohibit
124 Dispute
125 Discourage
126 Exclude
127 Embargo
128 Withhold Action
129 Discriminate

13 Force

130 Force
131 Destroy/Defeat
132 Compel
133 Press for
134 Retreat/Withdraw
135 Incite
136 Airlift
137 Sabotage
138 Deploy
139 Agitate

14 Grant

140 Grant
141 Provide
142 Give/Send
143 Contribute
144 Comply
145 Sell
146 Equip

15 Increase

150 Evolve
151 Expand/Increase
152 Enlarge
153 Intensify/Accelerate
154 Advance
155 Strengthen/Upgrade
156 Augment/Build-up
157 Gain
158 Reinforce
159 Escalate

16 Initiate

160 Create
161 Establish/Initiate
162 Organize
163 Embark
164 Enter into
165 Commence/Start
166 Announce
167 Launch
168 Raise
169 Approach

17 Maintain

170 Maintain
171 Continue/Remain
172 Persist
173 Integrate
174 Guarantee
175 Supply
176 Support
177 Retain
178 Wait and See
179 Do Nothing

18 Peace

180 Peace
181 Appease
182 Cease-Fire
183 Cease Hostilities
184 Conciliate
185 Bring to Terms
186 Disarm
187 Pacify
188 Reconcile

19 Possess

190 Possess
191 Have
192 Own
193 Occupy
194 Gain Operational Capability
195 Obtain
196 Store

20 Propose

200 Propose
201 Offer/Extend
202 Request
203 Invite
204 Assume
205 Invoke
206 Claim
207 Call for
208 Plan/Plan for

21 Protest

210 Protest
211 Complain
212 Hinder
213 Disrupt
214 Demonstrate
215 Demand

22 Pursue

23 Rely on

24 Reject

25 Restore

26 Relinquish

27 Take Countermeasures

220 Pursue

221 Seek/Ask for/Appeal

222 Carry out

223 Strive for

224 Proceed

225 Focus on

230 Rely on

231 Believe

232 Trust

233 Credit

234 Depend

235 Have Faith in

236 Reassure

240 Reject

241 Rebuff

242 Ignore/Unconcerned

243 Repudiate

244 Veto

245 Reconsider

246 Reverse

247 Slow Down

248 Isolate

249 Oppose/Disagree

250 Restore

251 Replace

252 Overhaul/Repair

253 Regenerate

254 Renew

255 Re-deploy

256 Resume

257 Re-institute

258 Return

259 Regain

260 Relinquish

261 Yield

262 Capitulate

263 Abandon

264 Release

265 Withdraw/Evacuate

266 Turn

267 Relax

268 Loosen

270 Counteract/Intervene

271 Contest

272 Resist

273 Block Sales

274 Divide

275 Orient

276 Transform

277 Diversify

278 Prevent

279 Confront

28 Terminate

29 War

280 End/Terminate

281 Cease

282 Stop

283 Break off

284 Lose

285 Complete

286 Consume

287 Eliminate

288 Fail/Stalemate

289 Remove

290 Attack

291 Invade

292 Bomb

293 Sink

294 Declare War

295 Mobilize

296 Combat

297 Engage in Battle

298 Wage War

299 Put on Alert

ALPHABETICAL LISTING - ACTION CODE WORDS

A

ABANDON	263	CEASE	281
ACCEDE	052	CEASE-FIRE	182
ACCELERATE	153	CEASE HOSTILITIES	183
ACCEPT	051	CHANGE	070
ACCOMPLISH	010	CLAIM	206
ACCUSE	020	COMBAT	296
ACHIEVE	010	COMMENT	080
ACQUIRE	030	COMMENCE	165
ADOPT	061	COMMUNICATE	107
ADVANCE	154	COMPEL	132
ADVISE	109	COMPETE WITH/FOR	091
AGITATE	139	COMPLAIN	211
AGREE	050	COMPLETE	285
AGGRAVATE	040	COMPLY	144
AIRLIFT	136	CONCILIATE	184
ALERT	299	CONCLUDE	019
ALLOW	053	CONCUR	057
ALTER	072	CONDEMN	025
ANNOUNCE	166	CONDUCT	090
APPEAL	221	CONFINE	044
APPEASE	181	CONFRONT	279
APPROACH	169	CONSULT	100
APPROVE	060	CONSUME	286
ASK FOR	221	CONTEST	271
ASSIST	068	CONTINUE	171
ASSUME	204	CONTRIBUTE	143
ASSURE	064	CONTROL	017
ATTACK	290	COOPERATE	056
AUGMENT	156	COUNTERACT	270

B

BARGAIN	096	CREATE	160
BELIEVE	231	CREDIT	233
BLOCK SALES	273	CRITICIZE	022
BOMB	292		
BREAK OFF	283		
BRING TO TERMS	185		
BUILD-UP	156		
BUY	032		

C

CALL FOR	207	DECIDE	014
CAPITULATE	262	DECLARE	082
CARRY OUT	222	DECLARE WAR	294
		DECLINE	122
		DECREASE	110
		DECRY	022
		DE-ESCALATE	116
		DEFEAT	131
		DEMAND	215
		DEMONSTRATE	214
		DENOUNCE	021

ALPHABETICAL LISTING - ACTION CODE WORDS (Con't)

DENY	120	FOCUS ON	225
DEPEND	234	FORCE	130
DEPLOY	138		
DESTROY	131	<u>G</u>	
DEVELOP	073		
DIMINISH	112	GAIN	157
DISAGREE	249	GAIN OPERATIONAL CAPABILITY	194
DISARM	186	GIVE	142
DISCOURAGE	125	GRANT	140
DISCRIMINATE	129	GUARANTEE	174
DISCUSS	106		
DISPUTE	124	<u>H</u>	
DISRUPT	213		
DISSIPATE	117	HAVE	191
DIVERSIFY	277	HAVE FAITH IN	235
DIVIDE	274	HINDER	212
DOMINATE	016	HINT	083
DO NOTHING	179		
		<u>I</u>	
<u>E</u>			
ELIMINATE	287	IGNORE	242
EMBARGO	127	IMPORT	094
EMBARK	163	INCITE	135
ENCOURAGE	055	INCREASE	151
END	280	INITIATE	161
ENGAGE IN BATTLE	297	INQUIRE	101
ENLARGE	152	INTEGRATE	173
ENTER INTO	164	INTENSIFY	153
EQUIP	146	INTERVENE	270
ESCALATE	159	INVADE	291
ESTABLISH	161	INVEST	036
EVACUATE	265	INVITE	203
EVALUATE	108	INVOKE	205
EVOLVE	150	IRRITATE	047
EXCHANGE	071	ISOLATE	248
EXCLUDE	126	<u>J</u>	
EXPAND	151		
EXPEL	041	JOIN	075
EXPORT	093		
EXPRESS	081	<u>L</u>	
EXPRESS CONCERN	089		
EXPRESS DISPLEASURE	089	LAUNCH	167
EXTEND	201	LESSEN	111
		LOOSEN	268
<u>F</u>		LOSE	284
FAIL	288		
FAIL TO SUPPORT	115		

ALPHABETICAL LISTING - ACTION CODE WORDS (Con't)

M

MAINTAIN	170	PURGE	046
MANIPULATE	097	PURSUE	220
MATCH	098	PUT ON ALERT	299
MEDIATE	102		
MERGE	074	<u>Q</u>	
MOBILIZE	295		
MODERATE	103	QUESTION	086
MOVE TOWARD	077		

R

N

NEGOTIATE	092	RAISE	168
		REALIGN	076
		REASSURE	236

O

		REBUFF	241
		RECEIVE	035
OBTAIN	195	RECOGNIZE	067
OCCUPY	193	RECONCILE	188
OFFER	201	RECONSIDER	245
OPPOSE	249	RE-DEPLOY	255
ORGANIZE	162	REDUCE	113
ORIENT	275	REFUSE	121
OUTBID	038	REGAIN	259
OVERBID	037	REGENERATE	253
OVERHAUL	252	REINFORCE	158
OWN	192	REINSTITUTE	257

P

		REJECT	240
		RELAX	267
		RELEASE	264
PACIFY	187	RELINQUISH	260
PEACE	180	RELY ON	230
PERMIT	054	REMAIN	171
PERSIST	172	REMOVE	289
PERSUADE	104	RENEW	254
PLAN/PLAN FOR	208	REPAIR	252
PLAY OFF	097	REPLACE	251
POSSESS	190	REPLY	087
PRAISE	066	REPUDIATE	243
PRESS FOR	133	REQUEST	202
PREVENT	278	RESENT	026
PROCEED	224	RESIST	272
PROCURE	032	RESOLVE	013
PRODUCE	031	RESPOND	088
PROHIBIT	123	RESTORE	250
PROMISE	063	RESTRICT	045
PROPOSE	200	RESUME	256
PROTEST	210	RETAIN	177
PROVIDE	141	RETARGET	078

ALPHABETICAL LISTING - ACTION CODE WORDS (Con't)

RETREAT	134	<u>U</u>	
RETURN	258		
REVERSE	246	UNCONCERNED	242
REVOKE	042	UPGRADE	155
REWARD	065	URGE	105

S

SABOTAGE	137	<u>V</u>	
SATISFY	015	VETO	244
SEEK	221	<u>W</u>	
SEIZE	043		
SELL	145	WAGE	298
SIGNAL	084	WAIT AND SEE	178
SINK	293	WAR	298
SLOW DOWN	247	WARN	023
SOLVE	012	WEAKEN	114
SPLIT	115	WELCOME	058
SPONSOR	062	WITHDRAW	265
STABILIZE	018	WITHHOLD ACTION	128
STALEMATE	288		
START	165	<u>XYZ</u>	
STOP	282		
STORE	196	YIELD	261
STRENGTHEN	155		
STRIVE FOR	223		
STUDY	108		
SUBVERT	048		
SUCCEED	011		
SUPPLY	175		
SUPPORT	176		

T

TAKE	033
TAKE COUNTERMEASURES	270
TAKE NOTE OF	085
TERMINATE	280
THREATEN	024
TRADE WITH	095
TRANSFORM	276
TRUST	232
TURN	266

JCS WORLD REGIONS

- 1 North America
- 2 Central and South America
- 3 Western Europe, the Mediterranean, and the Atlantic
- 4 Eastern Europe and the Soviet Union
- 5 Middle East and North Africa
- 6 South Asia, Indian Ocean and Sub-Saharan Africa
- 7 Pacific Area and East Asia
- 8 Polar Regions (Arctic and Antarctic)
- 9 Space
- 0 Other, Multiple Regions, the World

SUBSTANTIVE CODES

<u>General Category</u>	<u>Specific Breakdown</u>
01 Agriculture	010 Crop Production/Failure 011 Plant and Animal Diseases 012 Food Supply/Price 013 Fertilizers 014 Irrigation
02 Domestic Economics	020 Inflation 021 Unemployment 022 Labor 023 Productivity 024 Investment 025 Credit 026 Recession/Depression 027 Strategic Industry 028 Economic Development
03 Domestic Instability	030 Political Unrest 031 Communist Take-over 032 Civil War 033 Racial Disturbances 034 Insurrections 035 Secessionist Movement 036 Guerrilla Warfare (unaided by outside groups) 037 Coups d'etat 038 Purges
04 Domestic Political Processes	040 Changes of Government 041 Elections 042 Leadership Changes 043 Ideologies
05 Energy	050 Conservation/Use 051 Availability/Access 052 Resource Development 053 Fossil Resources 054 Geothermal/Solar 055 Nuclear Power 056 Economic Dependence 057 Water Resources 058 Production
06 Environment	060 Pollution 061 Weather Modification 062 Water Treatment 063 The Oceans 064 The Atmosphere 065 Natural Disasters

07	Force Readiness/Deployment	070	Manpower/Strength
		071	Base Rights
		072	Routine Force Deployment
		073	Operational Readiness
		074	Withdrawal/Reduction of Forces
		075	Increase of Forces
		076	Alert of Forces
		077	Operational Planning
		078	Projection of Force
		079	Balance of Force
08	Health and Welfare	080	Population Migration
		081	Population Growth
		082	Famine
		083	Epidemics
		084	Refugees
		085	Nuclear Accident/Incident
		086	Drug Control
		087	Mental Health
		088	Education
		089	Social Services
09	Intelligence Operations	090	Covert Intelligence
		091	Reconnaissance
		092	Satellite Surveillance
		093	Mapping
		094	Technical Intelligence
10	International Alignment	100	Alliances/Alignment
		101	Agreements/Understanding
		102	Treaties
		103	Ideologies of Major Actors
		104	US-NATO Disputes/US-EEC Political Disputes
		105	PRC-USSR Disputes
		106	East-West Disputes
		107	DC-LDC Disputes
		108	Other Disputes
		109	Joint Peacekeeping Effort
11	International Conflict/ Violence	110	Conventional War
		111	Unconventional Wars (with foreign involve- ment)
		112	Nuclear War
		113	Show of Force
		114	Naval Engagements
		115	Ground Combat Operations
		116	Air Attack/Action
		117	Bombardment
		118	Cease-Fire
		119	Surrender/Defeat

12	International Finance	120	Balance of Payments
		121	Currency Conversion
		122	Aid and Assistance Programs
		123	World Inflation
		124	World Recession/Depression
		125	Investment
		126	Economic Influence/Penetration
13	International Negotiation	130	Peace Negotiations
		131	Strategic Weapons Negotiations
		132	Conventional Arms Negotiations
		133	Size of Forces Negotiations
		134	Base/Territorial Negotiations
		135	Transit/Landing Negotiations
		136	Economic Negotiations
		137	General Negotiations
		138	Technological Negotiations
14	International Trade	140	Trade Agreements
		141	Cartels
		142	Embargoes
		143	Trade Restrictions
		144	Tariff
		145	Fishing Rights/Agreements
		146	Balance of Trade
		147	Critical Materials
		148	Technological Exchange/Transfer
15	Legal Processes/Justice	150	Law of the Sea
		151	Geneva Protocols
		152	Interpol
		153	Asylum
		154	Extradition
		155	Human Rights
		156	International Law
16	Military Assistance	160	Grants/Aid
		161	Arms Sales
		162	Training/Advisors
		163	Troop Support
		164	General Assistance
		165	Troops Sent
17	Military Capabilities	170	Overall Expenditures
		171	Strategic Delivery Systems
		172	Strategic Weapons Systems
		173	Strategic Defensive Systems
		174	Ground Systems
		175	Naval Systems
		176	Air Systems
		177	Communications
		178	Logistics/Support Systems
		179	Any Countermeasures

18 Research and Development

180 Energy
181 Industrial
182 Environmental
183 Health and Welfare
184 Communications
185 Basic Science
186 Military-Conventional
187 Military-Strategic

19 Terrorism

190 Sabotage
191 Hijacking
192 Piracy
193 Assassination
194 Hostage Taking
195 Nuclear Blackmail

20 Transportation

200 Highways
201 Air Transportation
202 Mass Transit
203 Ocean Shipping
204 Ship Construction

ALPHABETICAL LISTING--SUBSTANTIVE CODE WORDS

A

ACCESS - ENERGY	051	CREDIT	025
ACCIDENT - NUCLEAR	085	CRITICAL MATERIALS	147
AGRICULTURE	01	CROP FAILURE	010
AGREEMENTS/UNDERSTANDING	101	CROP PRODUCTION	010
AID PROGRAMS	122	CURRENCY CONVERSION	121
AIR ATTACK/ACTION	116		
AIR SYSTEMS	176	<u>D</u>	
AIR TRANSPORTATION	201		
ALERT OF FORCES	076	DEPLOYMENT - ROUTINE FORCE	072
ALLIANCES/ALIGNMENTS	100	DEPRESSION - DOMESTIC	026
ANIMAL DISEASES	011	DEPRESSION - WORLDWIDE	124
ARMS SALES	161	DEFEAT	119
ASSASSINATION	193	DISASTERS - NATURAL	065
ASSISTANCE PROGRAMS	122	DISEASE - ANIMALS	011
ASYLUM	153	DISEASE - PLANTS	011
ATMOSPHERE	064	DISEASE - HUMANS	083
AVAILABILITY - ENERGY	051	DISPUTES -DC-LDC	107
		DISPUTES - EAST-WEST	106
		DISPUTES - PRC-USSR	105
		DISPUTES - US-NATO	104
		DISPUTES - OTHER	108
		DOMESTIC ECONOMICS	02
		DOMESTIC INSTABILITY	03
		DOMESTIC POLITICAL PROCESSES	04
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BALANCE OF FORCES	079		
BALANCE OF PAYMENTS	120		
BALANCE OF TRADE	146		
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BASE/TERRITORIAL NEGOTIATIONS	134		
BASIC SCIENCE -R&D	185		
BLACKMAIL - NUCLEAR	195	<u>E</u>	
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CARTELS	141	EAST-WEST DISPUTES	106
CEASE-FIRE	118	ECONOMIC DEPENDENCE	056
CHANGES OF GOVERNMENT	040	ECONOMIC DEVELOPMENT	028
CIVIL WAR	032	ECONOMIC INFLUENCE/PENETRATION	126
COMBAT OPERATIONS - GROUND	115	ECONOMIC SANCTIONS	143
COMMUNICATIONS - CAPABILITIES	177	EDUCATION	088
COMMUNICATIONS - R&D	184	ELECTIONS	041
COMMUNIST TAKEOVER	031	EMBARGOES	142
CONSERVATION - ENERGY	050	ENERGY	05
CONVENTIONAL ARMS NEGOTIATIONS	132	ENERGY ACCESS	051
CONVENTIONAL WAR	110	ENERGY AVAILABILITY	051
COUNTERMEASURES	179	ENERGY CONSERVATION	050
COUPS D'ETAT	037	ENERGY PRODUCTION	058
COVERT INTELLIGENCE	090	ENERGY R&D	180
		ENERGY USE	050
		ENGAGEMENTS - NAVAL	114
		ENVIRONMENT	06

SUBSTANTIVE CODES (Con't)

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EPIDEMICS	083	INSURRECTIONS	034
EXTRADITION	154	INTELLIGENCE OPERATIONS	09
		INTELLIGENCE - COVERT	090
		INTELLIGENCE - TECHNICAL	094
		INTERNATIONAL CONFLICT	11
		INTERNATIONAL FINANCE	12
		INTERNATIONAL LAW	156
		INTERNATIONAL NEGOTIATION	13
		INTERNATIONAL TRADE	14
		INTERPOL	152
		INVESTMENT - DOMESTIC	024
		INVESTMENT - INTERNATIONAL	125
		IRRIGATION	014
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FAMINE	082		
FERTILIZERS	013		
FISHING RIGHTS/AGREEMENTS	145		
FOOD PRICE	012		
FOOD SUPPLY	012		
FORCE READINESS	07		
FORCE - SHOW OF	113		
FORCE DEPLOYMENT	072		
FORCES - ALERT OF	076		
FORCES - WITHDRAWAL/REDUCTION	074		
FOSSIL RESOURCES	053		
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GENERAL ASSISTANCE	164	LABOR	022
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GEOTHERMAL ENERGY	054	LEADERSHIP CHANGES	042
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GROUND SYSTEMS - CAPABILITIES	174		
GROWTH - POPULATION	081		
GUERRILLA WARFARE	036		
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HEALTH AND WELFARE R&D	183	MAPPING	093
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IDEOLOGIES - DOMESTIC	043	NATO-U.S. DISPUTES	104
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INDUSTRIAL R&D	181	NEGOTIATIONS - BASE/TERRITORIAL	134
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SUBSTANTIVE CODES (Con't)

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NEGOTIATIONS - STRATEGIC WEAPONS	131		
NEGOTIATIONS - TECHNOLOGICAL	138	SABOTAGE	190
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NUCLEAR BLACKMAIL	195	SECESSIONIST MOVEMENT	035
NUCLEAR POWER	055	SHIP CONSTRUCTION	204
NUCLEAR WAR	112	SHOW OF FORCE	113
		SOCIAL SERVICES	089
<u>O</u>		SOLAR ENERGY	054
OCEANS	063	STRATEGIC DEFENSIVE SYSTEMS	173
OCEAN SHIPPING	203	STRATEGIC DELIVERY SYSTEMS	171
OPERATIONAL PLANNING	077	STRATEGIC INDUSTRY	027
OPERATIONAL READINESS	073	STRATEGIC WEAPONS NEGOTIATIONS	131
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		SUPPORT SYSTEMS - CAPABILITIES	178
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PIRACY	192	SYSTEMS - GROUND	174
PLANT DISEASES	011	SYSTEMS - NAVAL	175
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POLLUTION	060	TARIFF	144
POPULATION GROWTH	081	TECHNICAL INTELLIGENCE	094
POPULATION MIGRATION	080	TECHNOLOGICAL EXCHANGE/TRANSFER	148
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PROJECTION OF FORCE	078	TRANSIT/LANDING NEGOTIATIONS	135
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FINAL NETWORK CROSS-OVERS FROM ONE NETWORK TO ANOTHER

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
E010101	E010301	M010301	P010901		
E010102	E010101 E010302 E010501	M010403 M010404	P010101 P010102 P010401	S010502	T010101 T010201 T010501
E010103	E010102		P010303 P010901	S010401 S010501	
E010104	E010103			S010502	
E010201	E010103 E010302		P010901	S010401	
E010301	E010201				T010501
E010302	E010102 E010401 E010501	M010601	P010102 P010801 P010901	S010501 S010502 S010701	T010501
E010401	E010101	M010501	P010302 P010901	S010502	T010201 T010501
E010501	E010101 E010301 E010302 E010401		P010101 P010901		T010501

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
M010101					
M010201		M010301 M010304 M010306 M010401 M010402 M010602	P010901		
M010301	E010101	M010201 M010304			
M010302		M010303 M010304 M010403			
M010303	E010501	M010302 M010305 M010307 M010402 M010403 M010502			
M010304		M010201 M010301 M010303 M010305			
M010305		M010303 M010304 M010401 M010403 M010404			

<u>Network</u>	Economic Networks with an Equivalent Node	Military Networks with an Equivalent Node	Political Networks with an Equivalent Node	Social-Psych. Networks with an Equivalent Node	Technological Networks with an Equivalent Node
M010306		M010304			
M010307		M010302 M010303 M010305 M010403 M010404			
M010401		M010201 M010305 M010403 M010602			
M010402		M010201 M010302 M010303 M010501 M010502 M010602	P010901		
M010403		M010305 M010306 M010401 M010402 M010404 M010501 M010602			

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
M010404	E010102	M010201 M010302 M010303 M010305 M010403 M010601 M010602			
M010501		M010402 M010502	P010901	S010502	
M010502		M010402 M010404 M010501 M010601 M010602	P010401		
M010601		M010302 M010304 M010403 M010404	P010101 P010701 P010801	S010401 S010701	
M010602		M010201 M010305 M010402 M010403 M010404 M010601	P010901		

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
P010101			P010901		T010201 T010202 T010602
P010102	E010101 E010102 E010401	M010601	P010401 P010801		
P010201			P010302 P010401 P010701		T010602
P010301	E010301 E010401 E010501		P010302 P010303 P010901		
P010302	E010301 E010401	M010403	P010303 P010401 P010701		T010602
P010303			P010401 P010601		T010202 T010501 T010601

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
P010401	E010102		P010102 P010201 P010302 P010501 P010701		T010501
P010501			P010401		
P010601					
P010701		M010404	P010201 P010302 P010401 P010901		
P010801	E010501	M010305	P010901		
P010802				S010401	
P010901	E010103 E010301 E010401 E010501	M010201 M010304 M010402 M010501 M010602	P010101	S010502	T010501
S010101			P010101		
S010401	E010301		P010701 P010802		

<u>Network</u>	<u>Economic Networks with an Equivalent Node</u>	<u>Military Networks with an Equivalent Node</u>	<u>Political Networks with an Equivalent Node</u>	<u>Social-Psych. Networks with an Equivalent Node</u>	<u>Technological Networks with an Equivalent Node</u>
S010501	E010401		P010101	S010101	
S010502	E010104 E010302 E010401	M010501	P010901	S010701	T010201
S010601					T010202
S010701	E010302 E010501			S010401	
T010101					T010201 T010501
T010201	E010401			S010501 S010502	T010101 T010501
T010202				S010601	
T010203			P010801		
T010501	E010102 E010501		P010102 P010303 P010801		T010101
T010601					
T010602			P010101		

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